

A MATHEMATICAL MODEL FOR THE OPTIMIZATION OF ADULT
EDUCATION FUNDING

By

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I dedicate this study to my wife Nancy N. Kimbrough; my daughter, Rachel L. Kimbrough; and my son, Andrew R. Kimbrough. Because of their love and support this dissertation was made possible.

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Abstract of Dissertation Presented to the Graduate School
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By

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Cochair: David S. Honeyman
Major Department: Educational Leadership

The purpose of this study was to develop and analyze a mathematical model to optimize the funding for adult education programs in Florida through the simultaneous solution of linear and nonlinear formulations. Multiple regression techniques were used to determine the mathematical model. Forward selection, backward elimination, and stepwise techniques were used to determine the variables to be included in the model. For purposes of this study, data items used in these formulations were evaluated using statistical techniques to determine their relevancy and validity.

One of the major problems of education is the reality of declining resources. The same forces affecting public education in pre-kindergarten through public elementary and

secondary programs also affect adult education programs. Since most states fund adult education programs with the funding allocated for pre-K through 12th grade, the growing needs for funds, combined with declining resources in kindergarten through 12th grade, will threaten adult education funding and may threaten the very existence of adult education programs. Thus, there is a need to allocate adult education funding in a more efficient and effective manner.

Twelve variables were used in the multiple regression analysis. Of these 12 variables, the variables that had the greatest effect on student success with the GED and the Adult High School Diploma were the state's expenditures on teacher salaries, the costs of other support services, and the costs of materials and supplies. Furthermore, three variables were found to be significant statistically to the increase in cost of adult education. These variables were the percentage of full-time teachers, the percentage of students involved in other educational programs, and percentage of students who resided in correctional facilities. Since the variables which affected success on the GED and the Adult High School Diploma did not coincide with the variables that affected total costs of adult education, a specific solution using simultaneous equations was not meaningful or possible. However, the study did conclude that the use of the formula developed from success on the GED and the Adult High School Diploma may be useful for determining the proper allocation

of funds. Future studies may be helpful in determining if mathematical models could be used to determine cost allocations.

CHAPTER 1 BACKGROUND OF THE STUDY

Introduction

One of the major problems of education is the reality of declining resources. State legislatures across the country are under increasing pressure not to raise taxes. State revenues generated by either income taxes, sales taxes, property taxes, or other personal or intangible property taxes will not be enough to meet the increasing costs of state services, including public education. Thus, the movement toward obtaining more education for less money has now become an important issue in many states. In order to meet the growing needs of public education, state legislatures are forced into the thoughtful allocation of tax dollars for education in the most efficient and cost-effective manner.

The same forces affecting public education in pre-kindergarten through public elementary and secondary programs also affect adult education programs. Since most states fund adult education programs with the funding allocated for kindergarten through 12th grade, the growing needs for funds, combined with declining resources in kindergarten through 12th grade, threaten adult education funding and may threaten

the very existence of adult education programs. Thus, there is a need to allocate adult education funding in a more efficient and effective manner.

Definition of Optimization

The definition of optimization used in this study is concentrated on making adult education funding as effective and efficient as possible. According to Webster's Third New International Dictionary, optimize means "to make as perfect, effective, or functional as possible" (p. 1585). Furthermore, the term optimization means "an act of optimizing or the fact of being optimized" (p. 1585). Thus, for this study, the term optimization will mean the act of optimizing adult education funding to make the funding both efficient and effective. In other words, if more monies need to be spent on certain areas or groups of individuals to make adult education more effective, then the mathematical model will be used to address the needs for additional funding in these areas or groups. Therefore, the model developed herein emphasizes the need for effectiveness and functionality rather than complete efficiency.

Background of the Problem

Florida will be adversely affected by the reality of declining state revenues and a growing and increasingly diverse student population. According to Natale (1992, October),

By 2010, if the demographers are right, one-third of all the children in the United States will live in just four states--California, Florida, Texas, and New York. Those four states--according to A Demographic Look at Tomorrow, a report that extrapolates from U.S. Census information--will see significant increases in the number of children in the next 20 years, mostly because of increases in what is now considered minority population. . . . In states with increases in the number of youths, the gains are largely attributable to gains in minority populations. And those increases point up another phenomenon of the future as well: Traditional minority populations--blacks, Hispanics, Asians--will become majority populations in some states. In California, Texas, and Florida, more than half of the youth population will be nonwhite well before the year 2010. (p. 24)

Although the growth in minority population in the public schools appears evident, the immediate need to train and teach the parents of these school children is even more critical. According to Edwards and Young (1992, September), "Recent hopes for successfully launching U.S. children into the 21st century have been pinned on reclaiming a part of our past--the involvement of parents as partners in the education of their children. The importance of parent involvement in children's schooling has been a persistent theme in the research and school reform efforts of the last three decades" (pp. 73-74). For example, Bronfenbrenner (1979) in The Ecology of Human Development: Experiments by Nature and Design and Henderson (1987) in The Evidence Continues to Grow: Parent Involvement Improves Student Achievement emphasized the importance of parental involvement in improving student performance. Thus the need to educate parents so they can help their children in school is evident.

Edwards and Young (1992, September) concluded, "Studies [Epstein, 1987; Heath & McLaughlin, April, 1987] point to higher student achievement when parents participate in school activities, monitor children's homework, and otherwise support the extension into the home of the work and values of the school" (p. 74).

The immediate need for English as a second language is evident in many counties in Florida. For example, one estimate lists 50 different languages spoken in Seminole County alone. Even more languages are spoken in Dade County. The realization that education of parents may have a direct influence on the success of their children further supports the thesis that more funding is needed for adult education in Florida.

Wood and Honeyman (1992) concurred with Natale (1992) that the changing diversity of Florida's school population will be a major factor in the growing needs for public education in Florida. Although Florida's growth rate recently has slowed, Florida's population continues to climb. According to Wood and Honeyman (1992), "The state [Florida] enjoys the uniqueness of being the fourth largest state in the nation as well as one of the fastest growing states. . . . Florida is projected to be the third most populous state by the year 2000" (p. 170). The financial burden on such a fast-growing state is also being experienced by other states. Natale (1992) wrote, "For schools, the

implications of a student boom are severe. 'It's a terrible time for states to be in a state of terribly rapid growth,' Hodgkinson [1988] says. 'With the deficit situation the way it is, there is no way for states to pay for [the growth]'" (p. 24).

Without new tax revenues Florida will be forced to reduce the extent of public education. Although funding for Florida's public schools has improved in recent years, the growth in population and language diversity of students may outstrip the availability of needed funds for education. According to Wood and Honeyman (1992), "During the period 1970 to 1973, several studies were conducted on Florida's finance system. Given the changes that were occurring, including growth and development in the southern half of the state, the legislature adopted recommendations to guarantee that students have access to an equal educational program" (p. 165).

This new program was titled the Florida Education Finance Program (FEFP). The standard for computing the state allocation was changed from a formula-based-upon-an-instructional-unit method to a weighted-average-per-pupil calculation based on cost calculations. Weights were determined for 26 student programs. Because adult education was funded in the same way as other public education programs, funding of adult education was governed by the assigned weights of the FEFP. Over the years, the Florida

legislature has changed the formula to reflect changes in population demographics. For example, in 1974 a cost-of-living differential was added. Although the state increased funding in real dollars during this period, funding declined during the 1970s. Wood and Honeyman (1992) wrote,

While approximately \$93 million in new money was made available to school districts, rising inflation and rapidly increasing costs in the state resulted in a \$78 per pupil increase in constant dollars. Per pupil revenue in constant dollars declined in 1975 as the legislature limited school boards to 8 mills total and included, but never funded, a sparsity adjustment factor. (Johns, 1975) (p. 166)

Further stresses on educational funding were experienced in the state during the 1980s. Because of political pressure to initiate programs to reduce taxes, the legislature lowered the required millage rate from 6.4 mills to 5.15 mills and also lowered the cap on total millage allowed to 6.75 (Wood and Honeyman, 1992, p. 167). Furthermore, the homestead exemption for property taxes was raised to \$25,000 in 1980-1981. The legislature attempted to cover these revenue losses with an additional levy of 2 mills for capital outlay expenditures. Wood and Honeyman (1992) stated,

During the period 1981 to 1990, Florida experienced incredible growth and development. To promote educational reform and assist school districts with increasing pressure for special populations, several programs were enacted by the legislature. Program cost factors and weights continued as the heart of the FEFP. By 1989 the number of cost calculations had grown from the original 26 (in 1973) to 41. The growth in program classifications was the result of increased need to address special education, special need, and at risk student populations. (p. 167)

Other improvement programs were the Dropout Prevention Act of 1986 (which indirectly affects adult education), PRIME, First Start, and other programs deemed necessary for preventing the loss of at-risk kids (Wood and Honeyman, 1992, p. 167).

Unfortunately, these programs did not eliminate the need for adult education.

Although the legislature addressed the need for more programs in pre-K through 12, the area of adult education was practically ignored. As a matter of fact, stringent enrollment caps on funding adult education have been in place since 1986. Without adequate increases in funding, adult education programs will not be able to meet Florida's future educational challenges.

The Current Status of Adult Education Funding in Florida

The review of research about the funding of adult education revealed that a comprehensive formula that optimizes costs for state and local funding of adult education has not been researched. Instead, states use a variety of funding methods already used in pre-K through 12 funding and for the community colleges to determine how funds are to be allocated for adult education. A majority of states use the foundation method for funding pre-K through 12 (Thompson, Wood, & Honeyman, 1994). According to the staff of the National Education Association Search (unpublished evaluative report, 1987), the methods currently used for pre-K through 12 education funding may be classified as flat

grants, minimum foundation, full state funding, and capacity equalization programs. Within capacity equalization programs are the percentage equalization (state aid ratio), guaranteed tax base, and guaranteed tax yield formulas. The effects of these funding formulas are varied and may or may not directly influence adult education funding. For instance, because much of the allocation of state funding for adult education may be finalized at the district level, the final funding for adult education may be decided at the local level and based on assessed needs, not on any particular formulas. There are several cases where the school district makes up shortfalls in funding for as much as 50% of the expenditures of the local district (Florida Department of Education, 1992-1993). These shortfalls may reflect a continual lack of adequate funding of adult education.

The Florida Education Finance Program (FEFP)

The current funding system for adult education in Florida's school districts is based upon predetermined weights for funding Adult Basic Education and Secondary Education and for educating the disabled (Florida Department of Education, 1993, May, p. 12). According to the 1993-1994 Florida Education Finance Program: Statistical Report, adult education funding was included in Group 3, which encompasses Adult Job Preparatory Vocational, Adult Supplemental Vocational, and Adult General programs. Because of fiscal priorities, an enrollment cap was established for adult

education. State funding is supplemented by student fees and tuition. According to the statistical report of the staff of the Florida Department of Education (1993, May), "Students who are enrolled in adult general and vocational adult programs who are reported for funding through the Florida Education Finance Programs must be charged tuition fees except those who are exempted by law" (p. 17). State statute (F.S. 239.117) provides a list of those students who are exempted from tuition or fees.

In addition to the current group status of adult education, certain weight factors are used to calculate "weighted FTE." According to the staff of the Florida Department of Education's Division of Public Schools (May 1993), "Multiplying the FTE students for a program by its cost factor produces 'weighted FTE'" (p. 12). Currently, the weight factors for adult education are .721 for Adult Basic Skills, .758 for Adult Secondary Education, and 1.140 for Adult Disabled. By multiplying the program cost factors by the FTE, the state determines the weighted FTE students. This figure of weighted FTE students is then multiplied by the base student allocation (currently \$2,501.05 per student) and the district cost factor. The product of these multiplications is then added to legislative-approved adjustments. For instance, the district might obtain additional supplements, such as the declining enrollment

supplements, sparsity supplements, and the hold harmless adjustment.

The present system of funding does not allow for increments based upon the meeting of goals or performance targets. Alamprese and Koloski (1992, March) mentioned the need for adult education programs to be given incentives. Because of the scarcity of resources, recent legislative proposals have centered upon the use of performance-based funding (PBF), which has been defined as paying for production rather than process. In education, competency based programs, such as those in adult and vocational education, were easily adapted to PBF, resulting in payment for student outcomes rather than "seat time." Student outcomes were typically measured as a percentage of program completers and job placements. Enrollments were considered positive student outcomes when recruiting certain populations, such as minorities or the disadvantaged. Although the definition of performance-based funding has been defined rather loosely, the possibility of conforming to such a funding model has been a major topic of discussion in adult education circles.

Community College Program Fund (CCPF)

Since 6% to 10% of the funding for adult education is provided by the community colleges, a review of the community college funding program is necessary. The Community College Program Fund (CCPF) is determined by following eight steps,

which become components of the funding formula used to fund the community colleges. These steps are as follows:

$$\begin{aligned} &\text{Base} + \text{Cost to Continue} + \text{Enrollment Workload} + \\ &\text{Operating Cost of New Facilities} + \text{Improved Programs} \\ &+ \text{New Programs} = \text{Total CCPF} - \text{Student Fee Revenues} = \\ &\text{State Funds CCPF.} \end{aligned}$$

In order to understand the funding process, one must review the meaning behind each step in the formula. The first step includes the base funding for the community colleges, and subsequent steps are added or subtracted from this base funding. First, the total state general revenue, lottery funds, and calculated student fees are included in the base funding for each college in the current fiscal year. Step two relates to the determination of the cost to continue current programs. The cost to continue current programs is added to the base. According to the The Fact Book 1991-92 (Florida Department of Education, 1992, Fall), "Using the amount of funds expended by each college in each of several expenditure categories, the price level guidelines are applied to these base amounts to determine the additional funds required to maintain the colleges' existing programs at their present level" (p. 91). Funds are then allocated to cost categories, such as salaries, general expenditures, utility costs, and operating capital outlay expenditures. Each of these sums is multiplied by the price guideline amount, and any additional funding required by each college

is determined. Even though all colleges are subject to the same guidelines, the resulting increases may not be the same because the colleges' spend money differently.

Step three relates to the identification of workload changes. According the The Fact Book 1991-92, "The statutes specify that the prior year enrollment shall be the basis of the assigned current enrollment" (p. 91). Last year's enrollment may be a determining factor in funding, even under conditions of high-growth rates. Step four was stated in The Fact Book 1991-92: "When a college adds a new building to its physical plant, additional operating costs are experienced. Based upon the specific college's average cost of operation per square foot, funding is appropriated for each new building's additional space to cover the cost of maintenance and operation" (p. 91). Thus any additional buildings that have been added to campuses will be reflected in increases in base funding.

Step five refers to funding for improving programs. According to The Fact Book 1991-92, "For programs for which the Legislature has previously provided funding, additional funds may be earmarked to improve or expand their delivery. Examples might be funding for the College Level Academic Skills Test, the Gordon Rule, and other such items which have been rolled into the program fund" (p. 91). Therefore, additional funds for program improvement are added to the base. Step six allows for additional funding to be added to

the base for new programs. According to The Fact Book 1991-92,

First time funding for systemwide programs specifically earmarked by the Legislature and which are to be rolled into the CCPF lump sum may be provided. Examples might include funding insurance rate increases or student advisement programs. Each college would receive a share of the total increased funds based on some distribution rationale. This might be FTE, headcount or other factors. (p. 92)

The seventh step is the process of adding the increases and decreases of steps 1 through 6 for each college and therefore determining the new funding base. Thus, each college will have a new total CCPF funding base. The Fact Book 1991-92 states, "Because factors other than FTE may be involved in distributing portions of the increased funding for all issues, it is to be expected that the increase per FTE and the overall percentage increase will probably not be the same for each college" (p. 92).

The final and eighth step is used to adjust the total CCPF funding base of each college for the calculation of student fees. Student fee collections are calculated by multiplying the assigned FTE enrollment by the standard fee rates. Once the student fees have been calculated, these fees are deducted from the total CCPF for each college to determine the state funding portion.

Thus, the state CCPF (Florida Department of Education, 1992, Fall) is clarified as the "lump sum appropriation for each college [that] is allocated to each local Board of Trustees to develop an operating budget for the college"

(p. 92). In conclusion, each board of each college may establish priorities for programs and expenditures to reflect the local needs or to satisfy the intent of the legislature expressed in the proviso language of the appropriations act.

Other Funding Methods for Adult Education

The rest of the funding for adult education originates from federal and state grants. Federal grants make up approximately 3% of the total funding for adult education in Florida. Even though this percentage is small, the need to examine the influence of federal funding is realized in the large number of small organizations funded by federal grants, including Hispanic Unity; Action, Inc.; and others. Because of the success of these organizations, it was necessary to include the funding for these organizations in this study.

The Purpose of the Study

The purpose of this study was to develop and analyze a mathematical model to optimize the funding for adult education programs in Florida. Since local districts may spend adult education funds in pre-K through 12 programs or may actually make up deficits in adult education funding, there is no formal method to determine the optimal funding needed in adult education. Therefore, an optimal funding model needs to be developed, subject to the variables affecting adult education and the budgetary constraints, and should be based on current funding (expenditures) for the 1992-1993 school year. An additional aspect of the study was

to determine relationships among the funding amounts estimated by the formula and student performance in the GED and ABE adult education programs in Florida. The research was designed to address the following subproblems:

1. A proposed, conceptually based formula was developed for the total optimal state funding of adult education programs for Florida.
2. The conceptually based formula was based on a production function that described the input-output relationship between selected variables.
3. The formula was used to determine the optimal combination of inputs to maximize output, subject to the budget and other constraints.
4. The formula was used to determine the optimal combination of inputs to maximize output, subject to certain constraints and given increments in the budget constraint.

Currently, the Florida Board of Education has experimented with several simulations of performance-based budgets. Because of the federally mandated requirements for adult education, these simulations include weights based upon the success of recruiting from target populations, status of students recruited, and activities provided by the adult education centers. The simulations do not attempt to look at the needs of the community that the center is attempting to serve. Furthermore, there has not been an attempt to optimize costs incurred in adult education. The methodology of this study included factors that were stated by the adult education administrators during personal interviews.

An alternative funding formula will have to optimize costs and include weights or factors relating to the success

of the center in accomplishing the goals of the adult education program. For example, as discussed previously, the problem of the current formula is that there is no measure concerning how successful the adult education center is in educating for the GED, ABE, or in educating a special student in the student's special programs. Such factors as student status, target populations, and center activities were included in the different weighted factors.

Need for the Study

The factors associated with estimating costs for adult learners are uniquely atypical (different) from funding programs for children and youths in grades K-12. Therefore, the attendance-based funding methods that are so common among K-12 funding are not appropriate for adult education funding. For example, Rose (1990) stated,

The attendance basis for distributing money has been problematical. It can contribute to the deterioration of standards of student performance. Students, particularly mandated students, know that they can sit around doing very little, take long unofficial breaks, and basically not be there except in body, if that is what they choose. As long as they are physically "attending," they will be carried on the books for funding purposes. (p. 127)

Furthermore, many single parents and minimally able students may benefit from attending a sheltered workshop environment without having to contribute to the adult daycare population. Finally, Rose concluded, "Another problem with attendance-based funding is that [it] can lead to discouraging the offering of desperately needed additional help to students,

if this help comes from outside agencies" (p. 127). Rickards (1983, September) would agree with Rose's discussion of adult education funding. According to the ERIC staff, which paraphrased Rickards,

The need for the program was determined because it was felt that the existing formula for disbursing adult basic and high school completion funds in Utah and other states (based on class membership and attendance) was burdensome to rural school districts and inappropriate to the needs and preferences of the adult learner. Learning options available for adult students included traditional classes, home study, competency testing, on-the-job training, computer-assisted instruction, audio-tutorial plans, televised instruction, performance-based instruction, and one-to-one tutoring. The program was found to be successful in that some adults benefitted by each approach, and all the approaches were at least as effective as traditional classroom instruction. The program was also cost efficient and, although time-consuming to administer, possible to administer on the local level. (pp. 14-15)

As a result of his study, Rickards (1983, September) recommended that Utah change its methods of disbursing funds for adult basic education and high school education. Moreover, no study was found in the literature that approached adult education from a comprehensive and totally funded process. Finally, the need for the optimization of school costs was best described by McAfee (1972):

It is hardly to be questioned that studies confined to the practical applications of models should be energetically pursued to provide, eventually, a firmer basis than now exists for dealing with broad questions of educational policy. Mathematical models, such as was developed in this study, allow decision-makers to form expectations of future consequences, these expectations being based on known empirical relationships and the decision-makers' judgements. (p. 156)

Consequently, there is a need to develop a conceptually analyzed formula for the total funding of adult education programs.

Definition of Terms

The following definitions for Adult Basic Education and Adult Education were obtained from the staff, Florida's Program and Plan for Adult Education, Florida Department of Education (1989-93).

Adult Basic Education (ABE) is defined as the

Provision of instruction for adults who are functioning at or below the eighth grade level. Such instructional services include reading, hand-writing, arithmetic, spelling, social studies, general (elementary) sciences, health, language arts, and consumer education for grade levels 1-8. Instruction in English-as-a-Second Language/English for Speakers of Other Languages (ESL/ESOL), adult life stages, aging process and resources and in life coping skills may be included. (p. 54)

Adult Education includes the

Services or instruction below the college level for adults: (a) who are not enrolled in secondary school; (b) who lack sufficient mastery of basic educational skills to enable them to function effectively in society or who do not have a certificate of graduation from a school providing secondary education and who have not achieved an equivalent level of education; (c) who are not currently required to be enrolled in school; and (d) whose lack of mastery of basic skills results in an inability to speak, read, or write the English language which constitutes a substantial impairment of their ability to get or retain employment commensurate with their ability, and thus are in need of programs to help eliminate such inability and raise the level of education of such individuals with a view to making them less likely to become dependent on others (Adult Education Act, 100-297, as amended). (p. 54)

Limitations and Delimitations

This study was limited to the adult education programs administered through Florida's 58 county school districts, 11 community colleges, and other institutions, such as public libraries and correctional institutions. Adult education programs housed in other community colleges were also included.

Estimates of transportation and child care were not included as possible additions to the funding of adult education because reliable data were not available for estimating costs. Furthermore, every effort is made by adult education administrators in Florida to locate the adult classes as close as possible to the residential areas of the students.

Although some questions have been raised about the accuracy of information reported about the success variables used in the study, no documentation was found that would support these affirmations. Similar views were also expressed concerning the data reported about public education in areas other than adult education. Since the federal government has rather strict procedures for reporting the results of adult education, it was assumed that the data employed in the study were valid.

This study assumed that all variables are nonnegative. This requirement of nonnegativity refers only to variables. Parameter estimates that demonstrate the effect of the

independent variables on the dependent variable may be negative.

Finally, there are limitations concerning the use of linear and nonlinear programming to optimize the production model. These limitations are discussed later in Chapter 3.

Organization of the Study by Chapters

This report of the study is organized into five chapters. Chapter 1 is an introduction to the problem consisting of a background of the problem, the current status of adult education funding, brief reviews of educational funding in Florida, the purpose of and need for the study, definition of terms, and limitations. Chapter 2 is a review of the literature. The procedures used in the study are described in Chapter 3. Chapter 4 consists of a presentation and discussion of the data. The findings, conclusions, and recommendations are given in Chapter 5.

CHAPTER 2 REVIEW OF THE LITERATURE

Introduction

Relevant literature concerning the need for funding, and the benefits of, adult education in the United States is presented in this chapter. Also included is a review of literature in opposition to adult education programs. This review was conducted through an ERIC search and a review of the literature of the University of Florida libraries. Technological inquiries included computer searches of ProQuest-Dissertation Abstracts; University Microfilms, Inc.; Dissertation and Master's Thesis Reproductions; LUIS (Online Card Catalog for all State of Florida university libraries; ERIC Microfiche; Silver Platter 3.1 of Psyclic; and the General Periodicals Index. Also included was a search through Education Index. The results of correspondence and interviews with state and local officials in adult education were of assistance in the review. The search primarily spanned a 10-year period prior to 1993.

The Need for Adult Education

The need for adult education is evident in a recently distributed report by the United States Department of Education. According to Kirsch, Jungeblut, Jenkins, and

Kolstad (1993, September), reporting on Adult Literacy in America: A First Look at the Results of the National Adult Literacy Survey, 21% to 23% or 40 to 44 million adults in the United States demonstrated skills in the lowest prose and quantitative abilities (Level 1: ABE), and 25% to 28% of the respondents, representing about 50 million adults nationwide, demonstrated skills at Level 2. The most shocking detail of the report was that the 90 million Americans who were performing only at Levels 1 and 2 did not realize they were "at risk." Only 21%, or 34 to 40 million adults, demonstrated literacy skills at the highest level of Levels 4 and 5. The need to educate adults not only in basic skills, but in the self-realization of their own abilities is evident in the report.

Beginning with the Smith-Hughes Act of 1917, Congress has demonstrated interest in vocational, adult, and community education programs (Costa, 1988). As a result of national concern, Congress passed the Adult Education Act (AEA) in 1966 (Costa, 1988). This act and subsequent amendments placed emphasis on basic fundamental skills for adults. The nation experienced increased educational needs for immigrants and refugees. The Comprehensive Employment and Training Act (CETA), passed in 1973, and Job Corps emphasized adult education for employment. Thus, the federal government has for many years been interested in the problem of providing for the educational needs of adults. As will be evident in

the following section, adult education is seen as essential in the development of a global economy and its accompanying social change.

Adult Education: An International View

The literature reveals that concern for the education of adults is an international concern. Adult education is a major issue in education in England, Canada, Sweden, and France (Gordon, Ponticell, & Morgan, 1991). Stock (1992) gave the following explanation:

In Europe, influenced by distinguished French thinkers and writers, we were beginning to grapple with concepts such as education permanente and the awesome operational implications for implementation. In the U.K., stimulated by a strong social-anthropological intellectual movement, professional adult educators were encouraged to investigate the concept and reality of "community": the relation of individuals to groups, and of groups to networks; and the montage of networks which constitutes "community." All this resulted in radically different approaches to devising and organizing adult learning programs for constituent communities, as well as to fundamental reconsiderations about the purpose of the whole educational endeavour. (p. 28)

The French and English have recognized the need for adult education and have also witnessed the social problems that result when adult education is neglected. Stock (1992) quoted a Final Report presented by the 1972 UNESCO International Adult Education Conference in the following (author's italic):

The widening gap between nations, groups and individuals constitutes the greatest moral challenge of our time. To close the gap is more than a question of social justice. In an era of ever-growing interdependence between countries and of increasing human wants, it is an economic imperative and precondition of world peace. This inequality is due

also to the unequal distribution of knowledge. But it cannot be solved simply by enlarging existing educational facilities. Experience shows that the provision of more education in most communities tends to favour most the already well-educated; the educationally under-privileged have yet to claim their rights. Adult education is no exception to the rule, for those adults who most need education have been largely neglected-- they are the forgotten people. (p. 29)

Educational leaders in Canada have also been interested in adult education programs. The importance placed upon adult education in Canada can be seen in the following quotation from Kulich (1992):

Adult learning and adult education have been important to Canada as an immigrant society since the early days. . . . With the increasing complexity of society and of social, economic, political and cultural issues facing the Canadian society and its members, adult learning and adult education become more and more important. Living in the global village of today and having to deal with the rapidly changing conditions, adult learning and education are crucial to the survival of society and individuals alike. (p. 45)

Although adult education has emerged as a great need in many countries around the world, adult educators are still faced with declining public interest and funding. Stock (1992) concluded with the following sobering prediction for the survival of humanity if adult education is ignored: "For unless we learn to change, adapt, negotiate and to re-learn, the ultimate challenge will be the very continuity of a species with any pretensions to humanity" (p. 33). Even though adult educators may have the best of intentions, most writers report little improvement in providing adult education. For example, Stock (1992) stated,

In the best local administrations the growing numbers of specialists in adult literacy, English as a second language, neighbourhood development, rehabilitation of offenders, or health education, were welcomed and incorporated into a holistic service of adult or community education. In the worst cases "private armies" were formed with little or no communication between one another. . . . External analysis of national level policy and practice suggested that the apparently "new" money directed to the special target-group programs was almost exactly commensurate with the cuts in grants to national providing bodies of liberal adult education and the general grants to local education authorities. (pp. 29-30)

As discussed previously, the literature emphasizes an international concern for adult education based on evidence of rapidly changing economic and social conditions.

Adult Education in the United States

Adult education in the United States has not been financed on a par with most educational programs. A study done by Kutner, Furey, Webb, and Gadsden (1990, November), to be reviewed subsequently, indicates that adult education funding has been relegated to the lowest priority in most states. However, as stated in the thesis of this study, adult education may be the most important asset to society. Yet, Cherem (1990) noted,

The poor stepchild remains in part due to adult education's professional associations, which have diverse interest, and typically, relatively small memberships. Without a coalescing of these associations' interest to common concerns, no sizable group exists to lobby policymakers. Unfavorable national policy and consequent funding formulas also stifle important movement in the field. (p. 23)

However, the United States cannot ignore the changes that are taking place. Cherem (1990) continued by stating the

following three major changes in society that will affect the field of adult education:

1. An exponential growth of information.
2. Changing demographics (i.e., the decrease in the base of taxpayers with children).
3. The emergence of a philosophy of adults' continuing development. (p. 24)

Social issues will become so great that the effects on adult education will be prominent.

The status of adult education in the United States was best presented in a U. S. Department of Education report titled Adult Education Programs and Services: A View From Nine Programs (1990, November). The authors of the report, Kutner, Furey, Webb, and Gadsden (1990, November), detailed four major aspects of adult education funding as follows (authors' italic):

1. The Adult Education Act represented the major Federal source of funds that supported adult literacy services in the sites studied. However, other major Federal programs such as JTPA [Job Training Partnership Act], FSA [Family Support Act], and SLIAG [State Legalization Impact Assistance Grants] were also important funding sources. The Family Support Act is expected to become a significant source of funding in future years.
2. Adult Education Act funds did not provide the majority of total funding for any site. For the eight sites that reported financial data--AEA funds represented 37 percent funding for one site, 11-12 percent at two other sites, and about 5 percent in two sites, and about 1 percent for the remaining two sites. One site did not receive AEA funding during the year of the site visit, but had received it in prior years.
3. Seven of the eight sites reported funding from at least one additional source of Federal funding than

Adult Education Act funds. Four sites had SLIAG funding--79 percent of all funds in one site, 54 percent in another, 20 percent at a third, and an undetermined amount at a fourth. Four sites had JTPA funding, with JTPA representing 11 percent, 8 percent, 6.5 percent, and 2 percent of funding in these sites.

4. States and localities also provided substantial support for adult basic education services. All sites received state funding. At five of the sites, state and local sources provided the majority of funding--ranging from 95 percent to 67 percent in those sites. (pp. ii-iii)

Kutner et al. (1990, November) observed,

Nationally, states reported a total of \$499.7 million spent on adult education programs in 1987, of which 19 percent (\$96.3 million) was Adult Education Act funds and 81 percent (\$403.5 million) was from state and local sources. However, two earlier studies have reported that some states may underreport adult education matching funds, providing only the minimum needed to qualify for Adult Education Act funding. (p. iii)

Thus, the funding of adult education by states and local school districts is a minimum requirement for participation in the federal program, which is itself at a low level of financial support. Insofar as funding is concerned, adult education is indeed a stepchild of the total education programs in the United States. The problem of inadequate funding is increasing because of federal decreases in financial support.

State Responsibilities Under the Adult Education Act

Kutner et al. (1990, November) wrote that the federal government has placed a number of administrative duties, reporting requirements, and fiscal responsibilities on the states. Each state is required to (1) develop a state plan

and report it to the Department of Education describing program needs, activities, and services; (2) allocate adult education funds to local districts; and (3) evaluate the effectiveness of all funded programs (p. 2). Kutner et al. (1990, November) also stated,

The Adult Education Act places a number of fiscal restrictions on the states. States are required to contribute a percentage of the Federal share of expenditures under the program. The Federal share is 90 percent for fiscal year (FY) 1989, 85 percent for FY 1990, 80 percent for FY 1991, and 75 percent for FY 1992 and thereafter. No more than 20 percent of a state's allotment may be used for high school equivalency services. States must spend at least 10 percent for corrections education and education for other institutional adults. States also must spend a minimum of 10 percent for special demonstration projects and teacher training. (p. 2)

Federal funds are distributed to the states based on the proportion of individuals in the state at least 16 years of age who have not graduated from high school and are not enrolled in a secondary school. The decline in the percentage of federal funding, coupled with an aging population, will force many states to reassess their support of adult education. However, as stated above, the need for adult education will remain, regardless of the source of funding.

Many states have supplemented these declining federal funds by supporting adult education programs with funds from local education agencies, institutions of higher education, and other nonprofit agencies or private corporations.

Florida's responsibility toward the Adult Education Act of 1966 is formulated in Florida's Program and Plan for Adult Education (Florida Department of Education, 1989-1993) and The Florida Adult Literacy Plan (Florida Department of Education, 1988). Both reports, submitted and approved by the U.S. Department of Education, list target populations and mention proposals for recruiting and educating these target populations. Unfortunately, Florida's refusal to meet some of the federal requirements has resulted in the loss of some federal funds. Nevertheless, the success rate of GED passing in Florida has increased despite the shortcomings of the state's plan. For instance, the number of persons passing the GED in Florida was 35,546 in fiscal year 1991, 32,722 in fiscal year 1990, 25,280 in fiscal year 1989, and 21,826 in fiscal year 1988 (Florida Department of Education, 1993a). Based on these data, the cap on adult education funding has not affected the general goals of adult education in Florida. However, actual passing rates were not reported; only the total number passing the exam was reported. Thus, changes in the need for adult education have raised new concerns for the inequities of financial support of adult education.

Inequalities of Support in Adult Education

Concern over changes in demographics and student diversity has driven the movement to reassess the needs of adult education. There has been a large shift in the emphasis on adult education from teaching ABE and GED

programs to offering programs for English as a second language. For instance, concern has been expressed regarding the ability of current school districts to teach students of multiple languages and cultures (Ward & Anthony, 1992).

Thompson, Wood, and Honeyman (1994) expressed the following concerns:

Of the 47.6 million children in school in 1992, more than 2 million faced severe language barriers, with some of the nation's larger school systems already approaching a majority of minorities. For example, Los Angeles's Limited English Proficient (LEP) students have increased from 15% of total school population in 1980 to nearly 50% in 1992. New York and Chicago also have huge language minorities speaking more than 100 languages, including Apache, Tagalog, Urdu, Cherokee, Greek, and Russian. Border states such as Texas have been especially affected, as in Brownsville where LEP enrollment in elementary grades reached 51% in 1989. LEP growth cannot be accurately estimated because the numbers are so large, but officials speculate that as many as 50% of school districts in some states may not be able to comply with bilingual mandates. (p. 16)

The lack of emphasis on the changing needs of adult education could have major ramifications in Florida. The Summary Report: Needs Assessment (Florida Department of Education, 1993b), dealing with the needs of adult education, did not emphasize the growing problem of immigration. The FDOE staff revealed that, of the total targeted population,

Only 2.29% were so restricted in language capability that they were identified as LEP [Limited English Proficiency] . . . LEP students were represented in the greatest percentages in Home Economics programs at 3.37%, followed by Business at 2.61% and Industrial at 2.57%. Public Service at 0.04% and Agriculture at 0.36% served the smallest percentages of LEP students. (p. 11)

Because many of Florida's migrant agriculture workers are from Hispanic backgrounds, the low percentage in agriculture

would lead one to conclude that the state is not recruiting enough individuals with LEP status. These percentages reflect the limited success of the adult education programs in recruiting individuals with limited English proficiency.

Although largely ignored in the literature, some political leaders in Florida are demanding greater emphasis on performance-based funding for adult education programs. Interviews with selected leaders in adult education revealed much opposition to this idea. But, as previously indicated, performance budgeting is primarily absent in the literature.

Benefits of Adult Education

This review of the literature revealed that many writers concluded that the benefits of adult education more than outweigh the costs. For many years, writers have promoted adult education as a potential solution to society's ills. The ever-present problems of crime, unemployment, and stagnant economy have been linked to the need for more adult education. As early as the 1960s and 1970s, adult education was considered a means to an end to America's growing social problems. Holtmann (1970, August 3) offered the following comment on this point:

There may be a number of reasons for the increase in efficiency of fellow-workers attributable to a comrade's ability to read and write. Workers may have to spend less time in instructing the formerly illiterate in simple machine operations, in correcting his mistakes, etc. In addition, it may simply be impossible to use certain production techniques when some members of the work force are illiterate. (p. 5)

Holtmann continued by concluding that a cost-benefit analysis of adult education should be based primarily on the assumption that the value of consumption in the society, given a certain distribution of income, is the goal of society. Other social goals of adult literacy education would be to redistribute income among certain racial groups, certain age groups, or regions. Social goals could include the stimulation of economic growth, the guarantee of a self-sufficient economy, and correction of the nation's balance-of-payments problems. Another benefit of adult literacy may have an indirect effect on the economy. For instance, the future strength of a nation's economy may be dependent upon the literacy of the future work force. Holtmann (1970, August 3) stated, "Another benefit associated with literate parents is the ability they gain in educating their children. There seems little doubt that part of the return from a child's education can be attributed to early investments of time and energy made in the home" (p. 4). Holtmann also noted,

There are certain types of external benefits that are derived from large numbers of people being literate. For example, the cost of collecting taxes to support government services may be lower for a largely literate population. Along these same lines, some of the benefits associated with literacy may exhibit some of the attributes of public goods. In this case, it will be impossible to determine the individual's willingness to pay for the benefits since by the nature of the goods he cannot be excluded from the benefits if he can read. (p. 5)

Arthur (1989) mentioned that the nonmonetary benefits of adult education may outweigh the costs because many students make several sacrifices in order to complete an adult education program and receive a GED certificate. Arthur added,

The implication of this theory [expectancy theory] for adult education is that those adults who perceive formal education as a means of fulfilling certain needs and who believe that they are able to complete the activity will participate. Those adults who do not share this perception of the value of education, or who lack the will, desire, or confidence to complete the activity, will most likely not participate. (p. 26)

Again, successful participants in adult education must come to realize that the benefits of their participation in adult education more than outweigh the costs.

Research that Supports the Funding of Adult Education

Holtmann's conclusions have been supported by several recent studies. According to a report (Utah State Office of Education, 1990, December) of Utah's adult education programs, "For every \$1.00 invested [in adult education], our state receives \$5.70 in saved, earned or returned income" (p. 1). The total savings were realized through new tax revenues of \$4,417,442 and public assistance savings of \$3,010,680. When these new revenues and cost savings were combined to make \$7,428,122 and compared to a total federal and state expenditure on adult education of \$5,179,667, the obvious benefits were realized. These findings were based on the following economic achievements:

1. Obtained a Job	3,091
2. Obtained a Better Job or Salary	1,320
3. Removed from Public Assistance	750
4. Unemployed Served	10,992
5. Public Assistance Recipients Served	3,307

The methods used to obtain the above information were not disclosed in the report.

A longitudinal study of adult education was conducted by the Department of Education for Iowa (State Board of Education, 1992, April). This study used telephone interviews and mailings to question GED graduates about their life status after graduation. Because of the importance of determining the benefits over different periods of time, the surveys were prepared for two, five, or more years after graduation. The findings support the benefits of adult education that were revealed in the Utah study. According to the Iowa study, the graduates' employment rate, job skills, and financial condition appeared to be improved. However, there was only correlated evidence of this improvement; evidence of the exact cause of these improvements did not exist. The study pointed out that "while nineteen percent of the respondents were unemployed and seeking work prior to passing the GED Tests, only nine percent were unemployed and seeking work in 1990" (p. xv). The success of the GED graduates was also reflected in the following statement by the staff: "Job skill level was measured by a five-point

scale on which 1 indicated low job skill level and 5 indicated high job skill level. The mean job skill level increased from 2.8 before passing the GED Tests to 3.5 in 1990" (p. xvi). One of the major benefits of the GED program was that it helped to make participants more independent of public assistance. The staff concluded, "Of the 192 respondents who received welfare prior to passing the GED Tests, 135 (seventy percent) had terminated welfare in 1990. Sixty-five (five percent) of those who did not receive welfare before passing the GED Tests did receive welfare in 1990" (p. xvii). Obviously, the results were mixed when reviewing whether possessing the GED really helped in taking individuals off of welfare. The overall change in those receiving public assistance was positive toward more independence. Furthermore, there were nonmonetary improvements such as improving general quality of life and becoming better parents. The passing of the GED test bolstered the participants' self-esteem and enabled them to help their children in their school work. The staff continued,

Of those in their thirties, the age group which was most likely to have school-age children, a majority of respondents (fifty-four percent) reported that passing the GED Tests helped them to assist their children in school "some" or "very much." In comparison, thirty-one percent of those in their late teens and twenties, who were likely to have pre-school children or no children, responded that earning a GED diploma helped them to assist their children in school "some" or "very much." (p. xxi)

This study reported several limitations. First, there was no control or relevant comparison of the group of adults who had earned traditional high school diplomas and those who had dropped out of high school and had not earned GED diplomas. Because of confidentiality, the researchers could not secure the names and addresses of those who had failed the GED test. Furthermore, the survey was subject to self-reported bias, even though the study's conclusions were based on the assumption that the respondents had answered truthfully. However, even with these qualifications the study has merit in that it further supports the contention that the GED is beneficial for both the recipient and society.

In another study in Wisconsin, the researcher came to the same conclusions that were found in Utah and Iowa. Hayes (1991, December), of the University of Wisconsin-Madison and the principal researcher in this study, noted,

A clear increase in the overall employment rate of the respondents is evident in Table 4. About 66% of respondents were employed full or part-time at the time of the survey in Spring 1991, as compared to 59% at the time of testing in Fall 1989. . . . Of the 114 individuals who reported receiving public assistance before earning the GED credential, 34 (29.8%) indicated that they had stopped receiving assistance at the time of the survey. (pp. 18-19)

Other benefits of the GED were stated, such as the enhancement of job advancement, increased skills as parents, and increased self-esteem. As was true for earlier studies, these nonmonetary factors could have influenced indirectly

the respondents' ability to improve the monetary rewards.

Hayes placed the following disclaimer on her findings:

One final caution is relevant when interpreting these responses. The perceptions of these respondents cannot be considered representative of all individuals who participate in GED preparation programs. This sample represents successful GED candidates alone, and it is logical to assume that there is a relationship between positive educational experiences and success on the GED test. While this limitation does not negate the positive perceptions of this study's sample, it does suggest the need to assess perceptions of a wider range of program participants, including program dropouts and individuals who are not successful in passing the GED exam, to gain a more comprehensive student assessment of GED preparation programs in Wisconsin. (p. 33)

Even with these limitations, the author believed that the surveys reflected the successes and benefits of adult education programs.

More recently, a study performed at the University of Akron found evidence of the benefits of adult education.

Daniels and Hess (1992, March 12-13) reported,

Clients scored higher on all parts of the Ekwall (Silent) following their participation in the PALS program. . . . The higher the client's performance on the SIT the higher the individual's performance on the TABE and Ekwall posttests. . . . PALS clients experienced positive and significant improvements in TABE Vocabulary, Comprehension and Total test scores. . . . [F]aculty revealed that during the course of the PALS program, adult learners (1) began to exhibit greater complexity in ideation; (2) gained greater control over mechanical processes such as punctuation and spelling; (3) expanded their writing repertoire from strictly personal narratives to include letters and creative stories. (pp. 3-4)

In a review of California's adult education programs, Stern (1989, February 9) concluded that the reason for the growing demand for adult education was as follows: "Demand

for high school basic skills instruction is increasing because (1) today's adults place a high value on high school diplomas and (2) high school students are enrolling in adult education programs to meet increased graduation requirements" (p. 41). Although the demand for at least a high school education is important for the work force, the indirect benefits of adult education must be recognized as well. For instance, as has been found in other studies, the researchers in the California study found that adult education contributed to helping students become better parents. California is one of the few states that has developed an evaluation system for English as a Second Language (ESL), Adult Basic Education (ABE), and adult special education classes. The California Adult Student Assessment System (CASAS) program assesses both student and program outcomes. Florida has administered the CASAS to individuals in its literacy programs on a nonrecurring basis (Staff, The Florida Adult Literacy Plan, Florida Department of Education, 1988, p. 12). The core of the CASAS program involves administration of tests to ESL and ABE students to determine whether or not an individual can perform 247 different life skills. Because these life skills are expressed as competency statements, 203 are within the general life skills content areas of Consumer Economics, Community Resources, Health, Occupational Knowledge, Government and Law, and Domestic Skills. The balance of the life skills are in the

area of Occupational Skills. Scores on CASAS tests are then used to evaluate student and program progress.

Mixed reactions have resulted from California's CASAS evaluation program. According to Stern (1989),

ESL students have gained between 6.1 and 7.3 CASAS scale points per year, while ABE students have gained on the average between 5.7 and 7.0 points per year. . . . In 1987-88 some 8,303 ESL and ABE students completed both the CASAS pre- and post-tests in life skills; overall, some 18,361 students in 1,312 classrooms completed CASAS pre- and post-tests. (p. 61)

The results of the California study must be qualified. For instance, Stern wrote,

The accuracy and year to year comparability of this productivity measure [CASAS scores], however, may be suspect since the assumptions have not been tested. Also, the CASAS sample may not be representative of the entire ESL and ABE participant population because (1) half of the students leave the program before taking the post-test (leavers may have different learning rates than completers of both tests) and (2) sample size and sampling and test administration procedures are not uniform across programs (nor is sampling uniformity required by the State Department of Education). (p. 62)

It is possible that the CASAS measures could be made more meaningful by linking analytically the number of hours a student attended the ABE/ESL program with his or her CASAS test score. This would be a burden that any evaluation system would need to overcome.

A Texas study also maintained the need for adult education. According to the report (Texas State Council on Vocational Education, 1988, December),

The Texas Strategic Economic Policy Commission reports that when the current dropout dilemma is added to Texas' current near bottom rankings in literacy and SAT scores among the states, "the implications for our state's

economic vitality are clear--a less educated and trained work force, and a greater demand for public service. (pp. 1-2)

The Texas study continued by reviewing the possible benefits of adult education.

Adult education could be instrumental in the development of a nation's future economy. Fagerlind and Saha (1989) expressed it this way:

The cumulative research evidence leaves little doubt that education can be a powerful agent of modernization. Education broadens perspectives and mental horizons, it instills new values and beliefs supportive of modernization programs and goals, and promotes national unity and identity. Furthermore, it provides individual opportunities for upward mobility, develops skills and knowledge important for technological and industrial change, and in general helps overcome immobile ways of thinking and immobile systems of social stratification and differentiation. (p. 110)

These benefits are based on the belief that a direct causal relationship of education on the modernization of individuals exists. These factors are particularly true when community college adult education programs are observed.

In conclusion, the benefits of adult education seem to rest on the needs of society. According to Dubay (1978), the educational needs of adults are often too complex to determine the obligation of the state for instructional programs. He indicated that "[a]s a general guide, however, we may observe that whenever the common welfare of the community requires that the adult population or a notable

section of it be given information of some kind, the government is bound to provide it" (p. 184).

Critique of the Studies Performed in Adult Education

Most of the research in adult education is based on surveys and opinion polls. Although the findings have merit, too often the inadequacies of such studies severely limit the ability of researchers to extend findings from the samples as generalizations of the population. Rose (1990), paraphrasing Smith-Burke (1987), evaluated adult education research in the following manner: "A further reason for the small voice of the community of adult education scholars on this topic is the 'pragmatic orientation' of the field. Of the 236 published articles on adult literacy between 1975 and 1980, less than a dozen would qualify as research" (p. 24). Beder (1991) quoted Fingeret (1984) in the following:

The literature in adult literacy education is voluminous, conveying the image of a substantive and useful knowledge base. However, a glance through an extensive bibliography, such as that generated through a thorough ERIC search, leaves the reader immersed in acronyms and discrete, site-specific reports that are difficult to relate to each other or to the planning of future efforts. In addition, the literature is spread over a range of disciplinary perspectives, confounding the difficulty of addressing such specific questions as "how do adults read?" (p. ix)

Much of the research in adult education has been based on surveys and expert opinions. Because of the diverse nature of adult education, attempts at evaluating the cost benefits have been lacking. For instance, in the Utah study (Utah State Office of Education, 1990, December) the findings

(i.e., obtained a job, obtained a better job, or removed from public assistance) were all based upon individuals who had attended and successfully completed the adult education programs and had passed the GED elsewhere. Unfortunately, the study does not indicate whether those who did not participate in adult education programs had achieved either less or more success than those who did. For example, the reader is not told of the percentage of individuals who passed the GED test but had not taken any adult education courses. Furthermore, if Utah had experienced a surge of economic growth, the same economic achievements experienced by the adult education participants might also have been experienced by those who had shunned adult education programs. Thus, who is to say whether adult education or passing the GED test contributed any real benefit to the Utah economy or state budget?

Other studies in adult education display similar weaknesses. For instance, the staff of the Iowa study (State Board of Education, 1992, April) admitted that there was no control or relevant comparison of the group of adults who had earned traditional high school diplomas and those who had dropped out of high school and had not earned GED certificates. Thus, the question of whether the GED or high school diploma really made any difference in the success of the individuals in question is not answered. Perhaps possessing a GED certificate was beneficial to the recipient.

However, it really is not known whether those without high school diplomas or GED certificates could have benefitted as well. Finally, the true value of the high school diploma is uncertain.

The Wisconsin study had the same weaknesses as the Iowa study. The researcher (Hayes, 1991, December) based all of her positive assumptions on the following: "[I]t is logical to assume that there is a relationship between positive educational experiences and success on the GED test" (p. 19). Unfortunately, there is little proof as to whether this relationship exists. Finally, Hayes admits that more studies are needed to assess the perceptions or successes of those individuals who dropped out of the program or were not successful in passing the GED test. Stearn's (1989, February 9) study of adult education in California fairs no better than the others. However, at least Stearn explains why he did not pursue a study of those who had failed the GED test. California's privacy laws interfered with his ability to investigate the failures of adult education programs.

In summary, the benefits of adult education to those who participate in the courses and are successful are unquestioned. However, determination regarding the benefits to overall society remain unanswered. Because of the light-weight nature of research in adult education, the determination of whether adult education benefits society will be a question for future research. For now, one may

accept the findings with their limitations and assume the general benefits of adult education.

Problems in Determining the
Sociological Benefits of Adult Education

Burket (1992) proposed that several social indicators would result from a lack of adult education. In his dissertation, Burket outlined such factors as increased crime rate, lack of voter registration, and other social ills as measures of problems resulting from a lack of an educated populace. According to Burket, "Minimally, it can be concluded that those with low educational attainment levels are more likely to be involved in crime, are less likely to vote or be employed, and are more likely to have low incomes and experience poverty" (p. 43). However, Drennan (1980) did not agree that the data support the social benefits of adult education:

For example, although few ABE/ESOL staff members ever mention to the recipients-students that a program goal is to get them off welfare, and the program may offer training only in basic skills, a plethora of ABE/ESOL programs use numbers-off-welfare data to judge their success. This is not valid evaluation. Equally invalid are the number registered to vote and voting, the number employed and upgraded on jobs, the number attending PTA meetings, the number reading the newspaper, the number with new library borrowing privileges, and so forth. To judge an educational program mainly on covert criteria is absurd. . . . This is not to say that ABE/ESOL never yields employment or increased citizenship activity or that these results should not be reported. They are important, but they are side effects. (p. 125)

The general literature in education has for many years assumed that society benefits directly from an educated

citizenry. However, the fact remains that no one has empirically evaluated the benefits of adult education.

The Benefits of Consumer Education

The benefits of consumer education have interested business and industry. Knapp (1991) noted in his survey report, "The Benefits of Consumer Education," that consumer education helps business and industry because it creates more educated consumers who are better able to make decisions about the products they are buying. According to an abstract of Knapp's (1991) survey report, "The responses provide evidence that modern consumer education teaches more than getting the best buy. Rather, it is a lifelong process essential to the economic well-being of society" (ERIC Document Number ED329772). Knapp further observed that consumer education offers several benefits to individuals:

(1) encourages critical thinking; (2) imparts life skills that contribute to success in everyday living; (3) promotes self-confidence and independence; (4) fosters broadly accepted values; and (5) improves the quality of life. In addition, consumer education offers several benefits to society: it encourages citizen awareness and promotes a stable society. (ERIC Document Number ED329772)

Additionally, consumer awareness offers several benefits to the business community.

In his research on the benefits of adult education in Michigan, Kwon (1990) revealed in a qualitative study the effect of a microcomputer application training program for adults. The program contributed economic and noneconomic benefits to its participants, business organizations, and

society. Finally, a follow-up study by Seppanen (1991, March) of the ABE and GED programs in Washington community colleges showed the following results: 77% of the respondents stated that they had a stronger self-image, 80% stated that they had met their individual goals of improving a basic skill, 50% believed that they had improved a skill that could be applied to their daily work, and 77% of the former students said that their lives had changed for the better since first starting the classes. Marson (1977, July) found, in a one-year cost benefit analysis study of nine full-time vocational technical programs and 36 adult education courses, that the benefits of these programs far outweighed the costs. According to Marson's report (1977, July), the cost-benefit ratio was 2.7 to 1.00 for society and 2.17 to 1.00 for an individual student. Again, although these percentages appear to place adult education in a favorable light, the study is plagued by many of the same limitations of the other studies. Because the study is so dependent upon the honesty of respondents, the study may be biased by the halo effect. In other words, because the respondents were successful, these individuals may have exhibited a positive attitude toward adult education--however unwarranted.

Within recent years some leaders in the Florida legislature have demanded that adult educators justify their programs through outcomes. Marson (1977, July) supported

this concept, which appears to be consistent with the growth of the accountability movement in the general field of education. Some political leaders in Florida are demanding that adult educators adopt performance-based budgeting.

Arguments Against Funding Adult Education

Over the course of history, the view that literacy could endanger the social structure of society was widely held by the aristocracy. Donald (1991) attributed to Davis Giddy, the president of the Royal Society in England during the 1800s, the following statement:

However specious in theory the project might be of giving education to the labouring classes of the poor, it would, in effect, be found to be prejudicial to their morals and happiness; it would teach them to despise their lot in life, instead of making them good servants in agriculture, and other laborious employments to which their rank in society has destined them. . . . [i]t would enable them to read seditious pamphlets, vicious books, and publications against Christianity; it would render them insolent to their superiors; and in a few years, the result would be, that the legislature would find it necessary to direct the strong arm of power against them. (pp. 214-215)

Not surprisingly, because the French Revolution had occurred not long before, the higher classes were dubious of educating the masses. Although this statement appears out of context in our modern world, some adult education administrators stated that some of today's employers exhibit the attitude that if their employees obtain more education, they will leave and go somewhere else. This attitude may seem surprising. Yet, some employers still think very much like Giddy. However, the birth of the public schools in the

United States foretold the movement toward educating the masses. Costa (1988) stated, "By this time [1918], all states have [instituted] compulsory school attendance laws; three states will later repeal theirs (South Carolina in 1955, Mississippi in 1956, Virginia in 1959)" (p. 7). Costa continued, "By this time [1927], most states have passed laws encouraging adult education. For example, California requires illiterates between the ages of 18 to 21 to attend school and has a literacy test for voters; Connecticut requires school districts with over 10,000 residents to maintain evening schools for persons over 14" (p. 9). Finally, during the 1960s and 1970s there were tremendous pressures on the states to support adult education programs. Many of these programs were supported by the Adult Education Act of 1966. Even with these movements, many experts are opposed to using public funds to support adult education.

The arguments against funding adult education have focused upon the economic benefits to society and to business firms. Because of increased automation and the decreasing need for workers, there is some question as to the need for adult education for the training or retraining of workers for different jobs. Hough (1987) postulated,

[S]ince unemployment is here to stay and therefore labour surpluses will continue in the majority of occupations for the foreseeable future, the government should establish the scale of training activity on the basis of social objectives. . . . [P]erhaps the main problem involved in so doing would be the heavy strain on public expenditure, quite apart from the economic

waste involved in providing training that might not subsequently be put to good use. (p. 114)

Drennan (1980) concurred with Hough:

In a society incapable of supplying enough jobs for everyone interested in working, these factors seem not to have been explored deeply by either adult educators or funders of adult education. In an economic sense the ABE/ESOL graduate who replaces the less-educated worker does not yield social profit; adult education programs often accomplish their goal of rendering graduates employable at the expense of already employed nongraduates. Thus the net gain to society at large is questionable. (p. 99)

Drennan further highlighted the difficulty of demonstrating a causal relationship between adult instruction and benefits to the individual in the following:

Even though many adults with limited basic skills who enroll in ABE programs probably are gambling on the purported causal relationship between education and income, economists state that the relationship between adult education and increased income has only the slimmest of documentation nationally. It is difficult to point to data which prove that a decade of remedial adult education programs has lessened the rate of either functional illiteracy among the undereducated adult public or their unemployment--in real numbers or percentages. (p. 99)

Since the beginning of history, the pursuit of adult literacy has been a subject of constant debate. As previously discussed, one argument holds that literacy might have a negative impact on society. For instance, Kaestle Damon-Moore, Stedman, and Trollinger (1991) wrote,

Although for purposes of public policy, increased literacy is assumed to benefit both individuals and the society as a whole, the association of literacy with progress has been challenged under certain circumstances. Paolo Freire has questioned whether literacy is a good thing for oppressed people if the content and conduct of literacy training are not under their control. From a variety of political viewpoints,

American and British culture critics of the 1950s questioned whether mass culture, including popular reading materials, was debilitating to its consumers. (p. 27)

Kaestle et al. quoted the Princeton historian Lawrence Stone: "[T]hat if you teach a man to read the Bible, he may also read pornography or seditious literature" (p. 27). Obviously, the teaching of literacy in adult education is dependent upon one's viewpoint, the illiterate individual in question, and whose benefit is under consideration.

As to proving the economic benefits of those who would become employed as a result of adult education, additional theoretical problems are identified. For instance, when examining the theories of the human capital approach, the true value of adult education becomes unclear. Fagerlind and Saha (1989) further observed that radical critics of education believe that adult education may create a "docile and adaptive work force which serves the needs of the power structure of the economy. For the radical critics, an education system which does not alter the structure of an inequitable capitalist society, does not contribute to the change and development of that society" (p. 49).

Research Findings Not in Favor of Funding Adult Education

As has been stated earlier, most of the research in adult education has been superficial. However, in one dissertation study by Huffman (1992), the benefits of funding vocational education appear mixed. Huffman analyzed the top

10 vocational education programs in Mississippi and compared the amount of funding the programs received with their individual rankings. Huffman reported the following important relationships.

1. The programs that spent less on teacher salaries had better rankings, which suggests that the programs were smaller and perhaps the students had more individualized assistance.
2. The less money spent on teacher travel--the better the ranking. More time with students may significantly increase enrollment, completion, and placement.
3. The less spent on contractual services--the better the ranking.
4. The less spent on supplies and materials--the better the ranking.
5. The intercorrelation did indicate that the less spent on facilities--the better the performance.
6. Equipment costs did affect the program performance ranking, but the less spent on equipment--the better the ranking.
7. The enrollment was related to costs and indicated that as enrollments decreased, program costs/FTE increased. (pp. 95-97)

Although these controversies apply to vocational education, the same expenditures may come into question in adult education. Would this mean that if less money were spent on adult education programs, there would be a higher success realized from adult education students? This is a question that is unanswered and may need further study.

Finally, another researcher discovered that the dollar amount spent on adult education courses may not be the issue. The real issue may be how the monies are spent on adult

education. As indicated previously, Rose (1990) found that "students, particularly mandated students, know that they can sit around doing very little, take long unofficial breaks, and basically not be there except in body, if that is what they choose" (p. 127).

Three adult education administrators who were interviewed in preparation for this study had mentioned the above dilemma. According to them, about 50% of the adult education students will never pass ABE Level 2 or reach the grade of 8.9. Thus, for perhaps 50% of the adult education students, the state monies may be wasted. Even worse percentages were revealed when discussing the percentage of those passing the GED or receiving the adult high school diploma and the total population of adult education students. Thus, the jury may still be out on the true value of present adult education programs.

Quantitative Methods Used for Evaluating Educational Programs

Few quantitative studies have been performed on the cost benefits of adult education. Except for Burket's (1992) and Huffman's (1992) related research in vocational education, few studies have attempted to relate the benefits of adult education with its costs. Such a study should add to the knowledge base in this area.

The use of systems like PPBS (planning-programing budgeting system) was emphasized during the surge of education acts passed by Congress in the 1960s. Because of

the need for efficiency and "getting things done," PPBS became a code word among educators during the 1960s and early 1970s. However, PPBS and related systems were not widely accepted in the field of education, and few of these systems survive today. In the field of vocational education, competency-based and performance-based evaluations have been used since the early 1970s. Many of these programs emphasized placement, so the final goal of employment was tied to the funding of the vocational program. Huffman (1992) wrote,

Several studies highlighted specific factors or outcome variables which should be analyzed in a technical-vocational performance evaluation, such as: enrollment data, job placement, community support, student performance, student aspirations, economic benefit, employer satisfaction, service to special populations, and overall cost-effectiveness. (p. 24)

However, limited literature exists concerning the use of competency-based or performance-based evaluation or funding in the field of adult education. One reason for such omissions is the special nature of adult education. Unlike vocational education, adult education does not have the goals of instructing the students in specific skills for specific jobs. Furthermore, employer expectations of vocational education graduates range from their possessing the ability to pass exams for licenses and certifications to their being able to operate complex machinery. These expectations are absent in adult education.

In order to review the literature most relevant to adult education, it is important to look at attempts at evaluating either K through 12 programs or programs in higher education, such as those at community colleges and universities. The literature centers upon the evaluation of costs incurred in a program. Most of the literature in adult education has utilized cost-benefit models for evaluation techniques.

For instance, Steele (1971, July) surveyed the possibility of applying cost-benefit techniques to adult education. She concluded that cost-benefit techniques were used in adult education programs that achieved economic outputs and were closely associated with industry. Steele concluded that, while cost-benefit models are useful in education, a more encompassing input-output analysis would be more useful because such a model could deal flexibly with human variables within an educational system. Marson (1977, July) also mentioned the possibility of using a cost-benefit method for evaluating adult education. In Marson's study, two cost-benefit models were tested on nine full-time vocational technical programs and 63 adult education courses, which reflected many different instructional areas in vocational technical education. His findings were that the benefits from vocational education programs and noncredit education courses did outweigh the cost of the courses. Even with these findings, the limitations on cost-benefit analysis

are such that other possible methods of evaluation have been suggested.

Determining the costs to assign to the benefits of adult education may be difficult. First, if Net Present Value (NPV) techniques are used, the researcher may have difficulty in selecting appropriate discount rates. Furthermore, the measurement and identification of indirect costs and nonmonetary benefits in an educational organization are difficult to apply to specific programs. Because many educational benefits are intangible and are difficult to quantify, the use of any costing formula would be held suspect as a means for measuring educational outcomes (Campen, 1986). Huffman (1992) observed,

Levine in 1981 noted that there were serious "data limitations and ambiguities" in cost-benefit analysis of human service programs. Shugoll and Helms (1982) and Levin (1983) indicated that cost-benefit analysis had significant limitations in measuring educational costs and benefits. Campen (1986) argued that cost-benefit analysis was "procedurally inappropriate" for establishing public policy since it attempted to subrogate the importance of "social ethics; rights, entitlements, and due process; the political process; and environmental values." (p. 46)

Rothenberg (1975) stated that "one of the truly serious difficulties in conducting cost-benefit studies is the lack of bases on which to value the flow of public services or the benefits from public projects" (p. 78).

The concepts of cost-effectiveness and cost-feasibility have been suggested as possible educational measures. According to Levin (1983),

Under cost-effectiveness analysis, both the costs and effects of alternatives are taken into account in evaluating programs with similar goals. It is assumed that (1) only programs with similar or identical goals can be compared and (2) a common measure of effectiveness can be used to assess them. These effectiveness data can be combined with costs in order to provide a cost-effectiveness evaluation that will enable the selection of those approaches which provide the maximum effectiveness per level of cost or which require the least cost per level of effectiveness. (p. 18)

However, Levin (1983) reported the following strengths and weaknesses of the cost-effectiveness model:

The cost-effectiveness approach has a number of strengths. Most important is that it merely requires combining costs data with the effectiveness data that are ordinarily available from an educational evaluation to create a cost-effectiveness comparison. Further, it lends itself well to an evaluation of alternatives that are being considered for accomplishing a particular educational goal. Its one major disadvantage is that one can compare the CE [cost-effectiveness] ratios among alternatives with only one goal. (p. 21)

The same problems that affect the cost-effectiveness approach also plague the cost-utility approach. Levin (1983) continued,

The major disadvantage is the fact that the results cannot be reproduced on the basis of a standard methodology among different evaluators, since most of the assessments are highly subjective ones that take place in the head of the person doing the evaluation. Another evaluator with the same information and methodology may derive a drastically different result by using a different set of probabilities and utilities. (p. 29)

Finally, Levin (1983) concluded that cost-feasibility analysis "can determine only whether or not alternatives are within the boundaries of consideration" (p. 30). Because of these weaknesses, an evaluation of adult education would be

best suited to an input-output model, which optimizes the outputs of adult education based upon the budgetary constraints existing at the time of the evaluation. Such a condition would imply that adult education programs can best be evaluated by using the input-output model. According to McAfee (1972),

The review of the literature appears to justify the following generalizations.

1. There is a need for decision-making based upon input-output relationships.
2. The challenge for input-output studies is to determine the proper mix of inputs that will maximize output.
3. In general, input-output studies have not interfaced with cost-effectiveness studies.
4. Serious reservations regarding methodology in input-output studies have been expressed.
5. A mathematical model is appropriate for systematically determining optimal allocation strategies. (p. 29)

Mathematical models have been used to determine funding for education in K through 12 and other educational programs (Johns, 1976, Fall). This mathematical model is discussed more fully in Chapter 3.

Chapter Summary

The release of a recently completed national study of adult education needs in the United States revealed that 90 million American citizens were seriously deficient in literacy skills, and many of these persons did not realize their predicament. Moreover, the literature indicated that

in other advanced nations (e.g., Canada, England, Sweden, France), there was an acute need for adult education programs. Some writers expressed concern for the survival of society without attention to adult education needs.

The emphasis for adult education programs was on program outcomes. Although the obvious social benefits of adult education were mentioned, the modern view of adult education was redirected toward cost effectiveness. More and more scrutiny was being placed on the success rate of adult education programs. According to an abstract of Mason's (1988) article, adult educators have not received the recognition for the contributions they have made to local economies; therefore, they should rethink their rationale, reject outmoded beliefs and patterns, and justify their work through program outcomes (ERIC Document number EF378460). Several programs have been reviewed and have been found to be beneficial to society. For instance, as indicated previously, Kwon (1990) remarked in a conference speech that a review of all qualitative data obtained from the Michigan study revealed that the program contributed economic and noneconomic benefits to the participants, the organizations, and society (ED326656).

The benefits of adult education are mostly accepted in the literature. Qualitative measures have been successful at determining the beneficial outcomes of adult education. However, the use of quantitative measures to evaluate adult

education programs has shown mixed results or has not been tried. There is little evidence that performance-based budgeting has been used in any educational programs. A review of the literature reveals no evidence of utilizing performance-based budgeting for funding adult education. Although their opinion was very much in opposition to traditional American thought about the value of an educated citizenry, some persons opposed the education of adults on the basis that helping persons become literate might make them unhappy with life and produce instability in society. But, some writers opposed adult education programs on the basis that they waste taxpayers' money in addition to creating additional problems for the government. Also noted was the opinion that further education of adults might destroy a stable source of unskilled labor and the economic system.

CHAPTER 3 PROCEDURES

Introduction

The purpose of this study was to develop and analyze a mathematical model to optimize the funding for adult education programs in Florida through the simultaneous solution of linear and nonlinear formulations. For purposes of this study, the evaluation of data items used in these formulations must be evaluated using statistical techniques to determine their relevancy and validity. Upon determination of their relevancy, further statistical analysis will help determine the variables that are key contributors of success in adult education.

Procedure of this Study

The procedure used for this study was to formulate production models and use stepwise linear and nonlinear programming techniques to optimize models to reveal the most efficient and cost-effective factors in adult education funding. By simultaneous solution of these models, the process would determine how adult education funding should be allocated to maximize the greatest outputs. Although this study utilized nonlinear models, a review of linear programming explains some of the complexities of nonlinear

programming. According to Sultan (1993), "In linear programming, one studies the best way to allocate limited resources" (p. 1). Dorfman, Samuelson, and Solow (1986) defined linear programming as "the analysis of problems in which a linear function of a number of variables is to be maximized (or minimized) when those variables are subject to a number of restraints in the form of linear inequalities" (p. 8). The present study utilized an input-output model to find the best way to allocate the resources of adult education.

Hillier and Lieberman (1974) pointed out that linear programming is based on four main assumptions: proportionality, additivity, divisibility, and that all parameters of the model are deterministic. They gave the following example of proportionality:

The assumption is that in this case (1) the measure of effectiveness Z [dependent variable] equals $C_k X_k$ [C is the coefficient of the independent variable X and k is the subscript of the activity for n activities or observations], and (2) the usage of each resource i equals $A_{ik} X_k$; that is, both quantities are directly proportional to the level of each activity k conducted by itself ($k = 1, 2, \dots, n$). [A is coefficient of the independent variable X for each activity k for each independent variable X]. (p. 22)

The magnitude of each effect is proportional to the amount of activity governing the effect in the model.

Hillier and Lieberman stated that "the additivity assumption requires that, given any activity levels ($X_1, X_2, \dots, X_n$), the total usage of each resource and the resulting

total measure of effectiveness equal the sum of the corresponding quantities generated by each activity conducted by itself" (p. 23). Of course, this assumption applies only to linear functions and would not always be possible for nonlinear formulations.

Hillier and Lieberman continued, "Therefore, the divisibility assumption is that activity units can be divided into any fractional levels, so that noninteger values for the decision variables are permissible" (p. 23). Finally, all parameters of the model must be deterministic. Although the parameters of nonlinear models sometimes are undeterminable, the necessity for known parameters limited the formulations used in this study. The solution of these parameters was estimated using multiple regression analysis, which is discussed later in this chapter.

Linear programming also entails certain properties that may or may not apply to some nonlinear models. Nonlinear models would be defined as mathematical models that involve nonlinear functions to describe the relationship between the dependent variable and the independent variables. First, this study assumed that all models were standard. According to Sultan (1993), "If we drop the requirement that all the variables be nonnegative in a linear program, then the program falls under the category of problems called nonstandard. . . . Unless explicitly stated otherwise, however, all programs will be standard. That is, all

variables will be ≥ 0 " (p. 50). This study assumed that all variables are nonnegative, with the requirement of nonnegativity referring only to variables. Parameter estimates that demonstrate the effect of the independent variables on the dependent variable may be negative.

Another assumption concerning most linear models is that they will be canonical. Sultan also stated, "Then we say that the linear program is in canonical form if all of the main constraints are equations, and we can pick out from each main constraint one variable that occurs only in that equation, and which has coefficient 1" (p. 52). Since the purpose of this study was to maximize outputs in response to restricted resources, a maximization program was adopted. Sultan continued by stating that a "standard maximum linear program is one in which (a) the objective function is to be maximized, (b) all the main constraints are of the type 'less than or equal to constants,' and (c) where all the variables are nonnegative" (pp. 149-150). Any maximization program can be made a minimization program by multiplying the models by negative 1. Sultan defined the minimization program as follows: "A standard minimum program is one where (a) the objective is to be minimized, (b) all the main constraints are of the form 'greater than or equal to constants,' and (c) the variables are nonnegative" (p. 150). Hence, this study focused on the maximization of the production model in order to maximize output.

Because the adult education field possesses many goals, this study needed to adopt a model to allow for the simultaneous solution of multiple optimizations. Goal programming could be used in linear programming to attempt to optimize multiple goals. While a company may use linear programming to maximize profits or minimize costs, goal programming allows for several goals to be resolved simultaneously. Sultan (1993) explained, "One great advantage of this technique is that it allows us to treat several objectives at once even though these objectives may be measured in different units, and even though these objectives may be incompatible" (p. 473). The goals of graduating from different ABE levels or obtaining the GED or simply transferring to a new educational program may be included in goal programming. Goal programming allows for several objective functions or production models, so that all goals are included in the optimization model. Although goal programming may be utilized to find solutions to multiple goals in linear programming, such formulations may fail because of constraint problems. According to Sultan, "Of course, there is the question of how we incorporate these goals into a linear program, since solving linear programs does not allow for the violation of the constraints" (p. 476). Sultan best describes the problems encountered with linear programming in the following:

If in a goal we are indifferent as to whether we underachieve or overachieve a target, then the variables

u and y both occur in the objective function. If it is more desirable that we underachieve a target than overachieve a target, then only the overachievement variable associated with that goal occurs in the objective function. If it is more desirable that we overachieve a target than underachieve it, then only the underachievement variable associated with the goal occurs in the objective function. . . . This also illustrates how drastically a solution can change by changing a goal. (pp. 479-480)

McAfee (1972) concurred with Sultan in the following:

"Consequently, it would be vain to hope to maximize the outcomes of each student in several different areas. In the utility function [optimization function or formula], only a few of the outputs would be maximized, at the expense of other outputs" (p. 51). Thus, any formulation that embraces the optimization of outputs with the attainment of several goals would require the complexity of nonlinear programming models. A study could utilize only linear models; however, linear programming is plagued with two major limitations that would not only decrease the magnitude of a study, but could jeopardize the purpose of the study, which is to determine how scarce resources should be allocated. According to Phelps (1992, March),

While Linear Programming appears to address most of the criteria, the remaining few are so critical that they easily become "fatal." . . . Non-linear Optimization addresses these two last criteria: (1) changing returns or nonlinear relationship between the Outcomes and the Effects; and (2) finding an optimal solution without having intersection between competing Effects (some positive and some negative). (p. 32)

Most importantly, the nonlinear programming model allows for a "built-in" balancing effect, so that effects that result in a negative value do not negate potentially positive characteristics of those same effects included as factors in the optimization model.

Phelps (1992, March) listed the following important properties of nonlinear modeling:

Non-linear optimization measures the multiple outcomes and the relationship between the outcome and effect in terms of the non-linear and bounded values. (p. 33)

Non-linear optimization easily uses the non-linear function of "cumulative standard normal probability." In many ways, this is the most unique feature of the education production model being presented. (p. 34)

Non-linear optimization allows--indeed requires--cost to be included as a constraint and provides the resulting interpretation of "what is the most efficient and effective combination of effects given the given costs constraint?" (p. 34)

Non-linear optimization allows the relationship between and among effects to be defined as additional constraints. (p. 34)

The properties of the constraints or boundaries of nonlinear models require further discussion. The constraints used in nonlinear programming are known as functional constraints, set constraints, and active constraints. According to Luenberger (1989),

It is clear that, if it were known a priori which constraints were active at the solution to (1) [minimize $f(x)$ subject to $h_1(x) = 0$ etc.], the solution would be a local minimum point of the problem defined by ignoring the inactive constraints and treating all active constraints as equality constraints. Hence, with respect to local (or relative) solutions, the problem could be regarded as having equality constraints only. (pp. 296-297)

Thus, for purposes of simplification, an assumption can be made where all constraints are equality constraints.

Nonlinear programming fits nicely with the needs of statewide budgets because of its magnitude. Luenberger (1989) stated,

There are many examples of nonlinear programming in industrial operations and business decision making. Many of these are nonlinear versions of the kinds of examples that were discussed in the linear programming part of the book. Nonlinearities can arise in production functions, cost curves, and, in fact, in almost all facets of the problem formulation. (pp. 305-306)

Since nonlinear programming was necessary for this study, alternative techniques for determining the parameters of the production model were required. Furthermore, the very complexity of nonlinear models required the use of computer-based solutions. Nakamura (1993) wrote:

The primary reason why we solve nonlinear equations by using computer methods is that nonlinear equations have no closed-form solution except for very few problems. Analytical solution polynomial equations exist up to the fourth order..., but there are no closed-form solutions for higher orders. Therefore, roots of those nonlinear equations are found by computer methods based on iterative procedures." (p. 65)

The methods by which the production model parameters are estimated will be discussed later.

Population for the Study

The population for this study consisted of all districts and adult education centers in Florida. Based on the information obtained from scholars of adult education, it was determined that accurate data on GED and ABE program

performance were indefinite for most of the states; however, all states must report annually to the federal government the results of their adult education programs. The data for this study were taken from Florida's reports to the federal government for the fiscal years of 1991-92 and 1992-93.

Research Design

The research design was based upon a data set with 85 observations for fiscal year 1992-1993 and 5 unduplicated observations from fiscal year 1991-1992 on 12 variables for the dependent variable (i.e., number passing the GED or receiving the Adult High School Diploma); 1 cost variable for all 90 observations based on the 85 local education agencies for fiscal year 1992-1993 and 5 unduplicated local education agencies for fiscal year 1991-1992 that offered adult education courses--all representing more than 1,300 data items. Even though the observations are from two different years, the 5 observations from fiscal year 1991-1992 are not duplicated in the 1992-1993 year (i.e., the same students were not included in both years' data). These 5 observations were from organizations such as Action, Inc., the Dozier Schools, Dixie County School District, Glades County School District, and Washington County Council on Aging, Inc. Therefore, inclusion of these local education agencies in the data increased the total number of observations to 90. Stepwise regression was utilized to determine the major factors influencing the success factors. Because of the low

observations to variable ratio (8 to 1), an alpha level of .05 was used to increase the power of the test statistics while using the stepwise method.

The two outputs, the GED and the Adult High School Diploma, were accomplishments verified, using standardized tests. These tests were either statewide or nationally recognized as demonstrating student achievement above a minimum level of educational attainment. Therefore, this study had verifiable evidence of student accomplishment with standardized tests. Although the attainment of the Adult High School Diploma required the completion of different courses than the courses used for preparing for the GED, both the Adult High School Diploma and the GED were considered equivalent. Also, the expenditures for adult education could not be allocated to either the GED students or the students of the Adult High School. Thus, the success on the GED was combined with completion of the Adult High School Diploma to create one success variable. Furthermore, passing rates for the students on either the GED or Adult High School Diploma were not available. Therefore, the dependent variable or success variable encompassed the percentage of the total student population who completed the GED or the Adult High School Diploma. The mathematical model was developed from the use of stepwise regression techniques by using the sum of the GED and Adult High School Diploma as the dependent variable. A second model which was developed from the

stepwise method was then used to determine the coefficients for the budgetary model. The final expenditures of fiscal years 1992-1993 and 1991-1992 for the 90 local education agencies were used as the dependent variable for the second model. Other important constraints were developed and used as constraints on spending. Finally, the first model was maximized by using a solution of simultaneous equations with the second model or budgetary model. Constraints on the maximization of the simultaneous resolution were included in the process of simultaneous equations.

The local education agencies included public school districts, community colleges, correctional institutions, other institutions, local libraries, and other state agencies offering adult education courses. To obtain the most current picture of the relationship between adult education funding and the many variables tested, the latest Adult Education Reports sent to the federal government were used as the source for all data items. These reports encompassed data collected for fiscal years 1991-1992 and 1992-93. Since any regression formulation must be based upon sound research theory, the 12 variables were selected because previous research revealed the importance of these variables in the determination of success in education. Furthermore, the federal government has mandated that these data items be reported annually to the U. S. Department of Education.

Statement of Variables

The independent variables associated with the participant inputs for the dependent variable of GED and Adult High School Diploma for adult education were listed by category.

The variables associated with student factors were as follows:

X1--Percentage of students (Adult Education students) who were enrolled in other educational programs. This percentage was calculated by dividing the number of students of each local education agency (LEA) who were enrolled in other educational programs by the total number of students at each LEA.

X2--Percentage of students who were female. This percentage was calculated by dividing the number of female students at each LEA by the total number of students at each LEA.

X3--Percentage of students who were handicapped. The percentage was calculated by dividing the number of handicapped students at each LEA by the total number of students at each LEA.

X4--Percentage of students who were eligible legalized aliens. The variable was calculated by dividing the total number of eligible legalized aliens in each LEA by the total number of students at each LEA.

X5--Percentage of students who were in correctional institutions. This percentage was calculated by dividing the number of adults in correctional institutions at each LEA by the total number of adults at each LEA.

X6--Percentage of students who were employed. The percentage was calculated by dividing the number of students who were employed for each LEA by the total number of students at each LEA.

X7--Percentage of students who were receiving public assistance. The percentage was calculated by dividing the number of students who were on public assistance and/or homeless at each LEA by the total number of students at each LEA.

The variables associated with school factors were stated as follows:

X8--Percentage of teachers who were part-time. This percentage was calculated by dividing the total number of part-time teachers by the total number of staff members in adult education. The staff in adult education was defined as the part-time teachers, full-time teachers, volunteer teachers, part-time paraprofessionals, full-time paraprofessionals, part-time counselors, and full-time counselors.

X9--Percentage of teachers who were full-time. This percentage was calculated by dividing the total number of full-time teachers by the total number of staff members in

adult education. The staff in adult education was defined as the part-time teachers, full-time teachers, volunteer teachers, part-time paraprofessionals, full-time paraprofessionals, part-time counselors, and full-time counselors.

X10--The ratio of state instructional salary expenditures over total expenditures. This was calculated by dividing the total instructional salary expenditures for each LEA by the total expenditures by LEA. Total expenditures included the expenditures of both state and federal monies for instructional salaries, contracted services or other personnel services, other expenses, and equipment.

X11--The ratio of state support personnel service or contracted services expenditures over total expenditures by LEA. This was calculated by dividing the total cost of other personnel services by the total expenditures by LEA. The total expenditures included the expenditures of both state and federal monies for instructional salaries, contracted services or other personnel services, other expenses, and equipment.

X12--The ratio of state expenses of material and supply expenditures over the total expenditures by LEA. This was calculated by dividing the total cost of other expenses by the number at each LEA by the total expenditures by LEA. The total expenditures by LEA included the total expenditures of

both state and federal monies for instructional salaries, contracted services or other personnel services, other expenses, and equipment.

The dependent variables used in the study were as follows:

Y1--Percentage of students who passed the GED or earned an Adult High School Diploma. This variable was calculated by dividing the total number of students who had passed the GED or earned an Adult High School Diploma for each LEA by the total number of students at each LEA.

Y2--The total adult education expenditures per student by LEA divided by 1,000. This was calculated by dividing the total costs (from both state and federal funding) incurred by each LEA and then dividing this number by the number of students of each LEA. The result of this calculation was divided by 1,000 for scaling purposes. Thus, actual coefficients have coefficients that have moved the decimal three places.

Selection of variables was based upon logic and, in some cases, convenience. Because the focus of this study was on the controllable costs of adult education, only the variables which could be controlled by Florida and which are the generator of expenditures for Florida were chosen. Most of the 12 variables which were used for the model were the only variables which the state could control for cost purposes. Therefore, the 5 observations for fiscal year 1991-1992 and

the 85 observations for fiscal year 1992-1993, which total 90 observations, represented an 8-to-1 ratio of observations to the variables. Multiple regression techniques were used to determine the major factors for the optimized model.

Although the number of legalized aliens and students enrolled in other educational programs were not reported on the 1992-1993 Federal Report, these variables had been reported in the 1991-1992 Federal Report. The number of legalized aliens and students enrolled in other educational programs had been reported for the three previous fiscal years of 1988-1989, 1989-1990, and 1990-1991. Therefore, these variables were included in the Adult Education Model.

Teaching in adult education in Florida is mostly done by part-time teachers from the pre-K through 12 program and volunteers. Some of the vital statistics for part-time teachers are listed in Tables 1 and 2. The totals for the volunteer counselors and paraprofessionals were excluded due to lack of data for these categories.

Since the state does not pay volunteers, teaching quality in the volunteer program is questioned. Furthermore, the state has no control over the number of volunteers recruited. Thus, since these volunteers are unpaid and the state cannot predetermine the number of volunteers recruited, the variables involving the number of volunteer counselors and paraprofessionals were ignored in this study.

Table 1

Vital Statistics on Part-Time Teachers for 1991-1992

Description	Number	Percentage
Part-time teachers	7,454	60
Full-time teachers	827	7
Part-time paraprofessionals	429	3
Full-time paraprofessionals	148	1
Part-time counselors	275	2
Full-time counselors	174	2
Volunteer teachers	<u>3,176</u>	<u>25</u>
TOTAL	12,483	100

Table 2

Vital Statistics on Part-Time Teachers for 1992-1993

Description	Number	Percentage
Part-time teachers	7,671	60
Full-time teachers	886	7
Part-time paraprofessionals	491	4
Full-time paraprofessionals	190	1
Part-time counselors	285	2
Full-time counselors	190	2
Volunteer teachers	<u>2,999</u>	<u>24</u>
TOTAL	12,712	100

The use of so many part-time teachers and para-professionals made the analysis of whether part-time teachers and paraprofessionals were better or worse than full-time teachers impossible. Also, certification is not required for many paraprofessionals. Thus, the quality of assisted teaching of the paraprofessionals was a major question that could not be answered. However, the costs to the state for these paid individuals made their presence significant to the study. Therefore, variables for the costs of these full-time and part-time teachers were used in the study.

As stated previously, forward, backward, and stepwise procedures were used to determine the parameter estimates of the linear equation. After these estimates were determined, two separate linear equations were developed using stepwise regression with two separate dependent variables. The dependent variables that reflected the successes or outputs of the two equations were the total number of individuals who either passed the GED or received the Adult High School Diploma.

After the two production equations were solved simultaneously, a nonlinear formulation was attempted. By using the PROC NONLIN command with SAS, the program used the Newton method of elimination to develop the nonlinear formulation, which best describes the process of adult education funding. The PROC NONLIN does not guarantee that such a developed equation is truly representative. Furthermore, an

examination of the results of the PROC NONLIN procedure should not be used unless the estimated model demonstrates a strong significance with the dependent variable.

As was stated previously, since some of the nonlinear equation calculations demanded nonanalytical solutions, the parameter estimates required the numerical solutions of nonlinear equations. Furthermore, the need to increase the number of variables based on further hypothesized effects required the use of analytical procedures. However, as will be seen in Chapter 4, linear models developed with multiple regression appeared to be the best equations for the purposes of this study.

Collection of Data

Data from the Florida Department of Education were used to construct and pre-analyze the proposed formula. Data about funding levels, GED and ABE performance, and related information were collected from directors of adult education programs in Florida, and the annual report, which is submitted to the federal government, was used for analysis of the developed formula. The annual report is not broken down by local education agencies. However, the reports that were produced by the individual local education agencies were summarized, so that specific data concerning each agency were obtained. Therefore, summary reports were used to develop the 90 observations that were discussed in the section titled "Research Design" (see p. 68). The numbers in these reports

were correlated using multiple regression techniques to determine the parameters of the mathematical models. Interviews from adult education administrators and expert faculty of adult education were also used to determine the funding effects and the estimate of the constants in the production function.

Although many of the experts interviewed in this study mentioned that transportation and child care would improve the success rates of adult education centers, these possible additions to adult education funding were not included. Because Florida political leaders have voiced strong opposition to transportation and child-care costs, these factors were not considered feasible as state expenditures. The emphasis was on feasibility of legislative approval of the factors included. Based on current information, it was decided that transportation and child care are not likely to be adopted now, or in the near future, by federal or state politicians. The emphasis in this study was on optimal outputs under existing legislation. Furthermore, because every effort is made to locate the adult classes as close to the residential areas of the pupils as possible, transportation was not considered a factor in the funding of adult education.

Analysis of Data

First, the data were analyzed using PROC MEANS and PROC CORR procedures on the SAS system. Because of the low ratio

of observations to variables, the most prominent variables were selected for study. The 5-to-1 ratio of observations to variables is a strongly recommended minimum ratio in research using multiple regression. According to Stevens (1992), "Many of the popular rules suggest that sample size be determined as a function of the number of variables being analyzed, ranging anywhere from two subjects per variable to 20 subjects per variable. And indeed, in the previous edition of this text, I suggested 5 subjects per variable as the minimum needed" (p. 384). In discussing stepwise discriminant analysis, Stevens wrote, "The F's to enter and the corresponding significance tests in stepwise discriminant analysis must be interpreted with caution, especially if the subject/variable ratio is small say < 5 " (p. 284).

Two major assumptions must be met when using multiple regression analysis to determine a regression model. According to Chatterjee and Price (1991), "The assumptions are (1) the explanatory variables are nonstochastic, that is, the values of the x's are fixed or selected in advance, and (2) the x's are measured without error. These assumptions cannot be validated, so they do not play a major role in the analysis. However, they do influence interpretation of the regression results" (p. 67). Once these assumptions have been accepted, then the researcher can follow certain steps to determine variable selection.

The major procedures usually employed by researchers to develop a mathematical model for testing are the forward selection method, the backward elimination method, and the stepwise method. The forward selection technique was employed first. In the forward selection technique, the F statistics are calculated for each of the independent variables. The results of the forward selection procedure revealed the variables which would give the largest F statistic and R squared. Chatterjee and Price (1991) reported,

The forward selection procedure starts with an equation containing no explanatory variables, only a constant term. The first variable included in the equation is the one which has the highest simple correlation with the dependent variable y . If the regression coefficient of this variable is significantly different from zero it is retained in the equation, and a search for a second variable is made. The variable that enters the equation as the second variable is one which has the highest correlation with y , after y has been adjusted for the effect of the first variable, that is, the variable with the highest simple correlation coefficient with the residuals from step 1. The significance of the regression coefficient of the second variable is then tested. If the regression coefficient is significant, a search for a third variable is made in the same way. The procedure is terminated when the last variable entering the equation has an insignificant regression coefficient or all variables are included in the equation. (p. 236)

The backward elimination method is described by Agresti and Finlay (1986) as follows:

The backward elimination procedure works in the reverse direction from the forward selection method. In backward elimination, we begin by placing all of the independent variables under consideration in the model. If they all make significant partial contributions, then that model is the final one. Otherwise, the independent variable having the least absolute partial correlation

with Y, controlling for the other independent variables, is removed from the model. Next, for the model with that variable removed, the partial correlations with Y and each X_i (controlling for the other variables still in the model) are recomputed. If they are all significant, that model is the final model. The process continues until each remaining independent variable makes a significant partial contribution to explaining the variability in Y. (p. 379)

The stepwise procedure was performed in addition to forward and backward elimination. According to Chatterjee and Price (1991),

The stepwise method is essentially a forward selection procedure but with the added proviso that at each stage the possibility of deleting a variable, as in backward elimination, is considered. In this procedure a variable that entered in the earlier stages of selection may be eliminated at later stages. The calculations made for inclusion and deletion of variables are the same as FS and BE procedures. Often, different levels of significance are assumed for inclusion and exclusion of the variables from the equation. (p. 237)

In order to select the proper variables needed in the model, the researcher determined the theoretical significance to the model. In other words, common sense, past research, or sometimes just plain guessing was used to determine the variables that should be included in the model.

The summarized results of the backward elimination method listed the variables that were considered by the stepwise method. Although the original ratio of observations to variables was 8 to 1, the true ratio of observations to variables was much higher because the final summary of the backward elimination method included only the variables considered in either the forward selection method or the

stepwise method. Therefore, the final ratio of observations to variables became much higher than 10 to 1.

Even though there is a need to address theoretical considerations and to choose the best method of variables selection, the major purpose of this study was exploratory. Agresti and Finlay (1986) concluded, "In exploratory research, on the other hand, the goal is not to explain relationships among variables so much as it is to find a good set of predictors" (p. 380). Thus, the purpose of this study was to predict the optimized cost of adult education funding in Florida.

According to experts in adult education, the measures of success, for which data were considered most reliable, were graduation rates on the General Education Development (GED) test and completion rate for the Adult High School diploma, as defined by the Florida's Program and Plan for Adult Education (State of Florida, Department of Education, Division of Vocational, Adult, and Community Education, 1989-1993). These success variables were treated as dependent variables in order to determine if changes in adult education funding affected success variables.

The constraint on maximization of outcomes was the funding level of adult education based upon the total expenditures for adult education from all 90 local education agencies for fiscal years 1991-1992 and 1992-1993. The two regression equations were determined using the several

variables stated above. The B coefficients were estimated using multiple regression analysis, and the final optimized formula was determined using both linear and nonlinear programming techniques, as discussed below. The production model (first model) is stated as follows:

$$Y1 = L1 * (B1)X1 + L2 * (Bn)X2 + \dots Ln * (Bn)Xn.$$

The above production function was determined from the stepwise regression performed on the first dependent variable Y1 and the 12 independent variables stated previously. This production function was solved subject to the expenditure model (second model):

$$O1 \geq L1 * (B1)X1 + L2 * (B2)Xn + \dots Ln * (Bn)Xn.$$

The above constraint was determined by using the coefficients which were calculated using stepwise regression for the variable Y2 and the corresponding 12 independent variables. The variable O1 was the total expenditures for adult education for fiscal year 1992-1993 and the total expenditures for the 5 selected LEAs for fiscal year 1991-1992. This total was then adjusted for possible errors of truncation.

Equation symbols were defined as follows:

Y1 = The amount of the outcome based upon the performance of a local education agency (passing the GED, receiving the Adult High School Diploma).

O1 = The total expenditures for adult education for Florida divided by 1,000. [The division by 1,000 is required to scale the total expenditures in order to prevent truncation errors (\$1 = \$1000).]

Ln = The unit measure of the effect in a nonlinear function.

Bn = The magnitude of the relationship or the coefficient obtained by using stepwise regression.

Budgetary constraints were based on the funding (expenditures) of each district in Florida. The equation of the funding of budgetary constraints was as follows:

$$T_n \geq X_n \geq M_n.$$

Tn = The minimum level of the respective effect.

Mn = The maximum level of the respective effect.

Xn = The variable representing the amount of the respective effect.

Since the above equations were generic to the many outcomes of the simulation, a more specific listing of the several outcomes was revealed, and the result of the simultaneous equations was one final production equation. The final equation for the production model was as follows:

Y1: Completion of the GED and Adult High School Diploma.
The equation would be as follows:

$$Y1 = Z1 * P1 + \dots Z_n * L_n.$$

The symbols for the above-stated equations were as follows:

P_n = Vector of student or school factors to the n th local education agency.

L_n = Vector of school factors by the i th local education agency.

Z_n = The nonlinear effect of each of the above vectors. The mathematical model states the outputs of an individual (n th) LEA equal the profile of the student P_n and the LEA's contribution to education L_n .

Development of Vectors to Determine Effects and Magnitude of Effects

The variables used in the least-squares equations were the many data items obtained from Florida's Adult Education Annual Performance Report, Fiscal Year 1993. These variables were grouped by their effects of community inputs, school inputs, student ability inputs, and the endowment position of the student. Since this study required that nonlinear programming be used to optimize adult education funding, a review of the techniques to determine the production model's parameters was necessary. The estimations of a model's parameters were performed using either analytical or numerical techniques. Much of the research, particularly in engineering and science, has emphasized numerical techniques. However, the social sciences have used more analytical techniques, such as the stepwise regression method. McAfee

(1972) used such stepwise regression techniques in his study on K through 12 funding. According to Darlington (1990),

The first method is stepwise regression. Standard computer programs for stepwise regression differ from each other more than do standard programs for ordinary regression, so we shall describe the method only in general terms. Both "forward" and "backward" versions exist. (p. 165)

In this study the stepwise regression model was used because of its simplicity. Furthermore, any additional predictions for production function parameters used the stepwise regression method.

The SAS computer program was utilized to determine the parameters or fitting of the nonlinear relationships of the production functions. Darlington (1990) stated,

There are some very general methods for fitting curves or curved surfaces to data, as represented, for instance, in SAS PROC NLIN or the STSTAT program NONLIN. These are sometimes called nonlinear regression methods. However, they are in fact not based on regression methods, so we might better call them general curve-fitting methods. (p. 279)

The estimates of the coefficients of the production function were estimated by using multiple regression analysis. After the production function was determined, the production function was solved with the budgetary constraints by using mathematical programming. A software program using the SAS statistical package was used to solve simultaneous equations. The results of the simulations are presented in Chapter 4.

CHAPTER 4 PRESENTATION OF THE DATA

Introduction

As stated previously, the purpose of this study was to develop and analyze a mathematical model to optimize the funding for adult education programs in Florida. The simultaneous solution of linear and nonlinear formulations was attempted to develop the mathematical model. The final mathematical model created by the procedures in this study was formulated using raw data concerning adult education. Because the data used for development of the model were so crucial to its final appearance, an extensive analysis of the data was completed in order to ensure that all statistical assumptions governing the model had been satisfied.

Analysis of Data

The SAS statistical program on the University of Florida's main frame was used to analyze the data. The data set was then examined by looking at the listings of these procedures.

The data set included a total of 5 observations for fiscal year 1991-1992. An additional total of 85 observations were noted in the second data set representing fiscal year 1992-1993. As was stated in Chapter 3, the 5

observations in fiscal year 1991-1992 were not duplicated in fiscal year 1992-1993. Therefore, these 5 observations were independent of the 85 observations in the fiscal year of 1992-1993. The total of 90 observations were then available to develop a model from regression analysis. The total list of LEAs used in this study is presented in Appendix B.

Since most researchers adhere to the rule of thumb that no more than 10% of the number of observations for each variable may be missing, the total number of missing data items allowable for this study would approximate nine for the combined observations of fiscal years 1991-1992 and 1992-1993. One of the contributing factors in selecting variables was the presence or absence of data items. However, if the variables were considered important, then, regardless of the "shape" of the data items, these variables were included in the model.

The data base was fairly complete for almost all of the variables. However, some of the local agencies either failed to turn in their report or were delinquent in doing so. As shown in Table 3, for fiscal year 1992-1993, Local Education Agency (LEA) A was missing all items of data for all of the variables except the costs expended for adult education. Because of this omission, the complete records for LEA A for fiscal year 1991-1992 were used in its place. Of the four observations in 1991-1992 (excluding LEA A), LEA D also was void of any data items except for costs data items. Again,

there is no explanation for the absence of data from either LEA A or LEA D.

Table 3

Accumulated Missing Items

Total observations in analysis	90	Data Missing
Observations with missing data:		
LEA A (1992-1993)	-1	All data items except costs.
LEA B (1992-1993)	-1	Correctional facilities. Legalized aliens.
LEA C (1991-1992)	-1	Full-time & part-time teachers, counselors, & full-time para-professionals. Volunteer teachers.
LEA D (1991-1992)	-1	All data items except costs.
LEA E (1991-1992)	-1	Receiving Public Assist. All teaching, counselor, & paraprofessionals.
LEA F (1991-1992)	-1	Full-time teachers, counselors, para-professionals. Volunteer teachers.
Total missing items	-6	

Other missing data items restricted the researcher's ability to maintain a data base that included all school districts in the study. For example, many of the

observations of fiscal year 1991-1992 were incomplete as to variables relating to teaching. Thus, the part-time teaching variable contributed to the total of missing variables because of missing data items for LEA C and LEA E. Another organization (LEA B) was missing data items for the variable of X5 (Participants in Correctional Institutions). Finally, the absence of a data item for RP (Receiving Public Assistance) for LEA E created another missing data item.

The accumulation of missing data items, therefore, contributed to the information presented in Table 3 (of items missing) during the researcher's development of a mathematical model.

Although the number of missing items was high compared to the total number of observations, the absence of any reports from LEA A and LEA D made at least two missing items inevitable. Fortunately, the missing observations were less than 9% or 10% of the total observations. Because of the absence of these data items, the number of variables to be examined was restricted to 12.

Also, influential outliers were not found, even though the plots of studentized residuals versus the dependent and predicted dependent variable did show four outliers. This was not influential because from Cook's D (Appendix C) it was noted that all of the observations had more or less the same values, and only two of them were greater than or equal to unity, hence indicating that none of the outliers were

influential and needed to be deleted. Furthermore, the observations which were missing data items were omitted from the analysis. The outliers identified by Cook's D procedure were as follows:

Observation for Department of Corrections

Observation for LEA A and D

Observations for LEA C, LEA E, and LEA F

were missing so many items that they were not evaluated by Cook's D.

The observation of the Department of Corrections was kept in the analysis because the Department of Corrections would always appear to be unusual, based upon funding and number and types of participants. Observation 90 is an unexplainable outlier. Perhaps the fact that the observation came from fiscal year 1991-1992 explains its values. The observations of LEAs B, C, E, and F were utilized in the regression analysis because these observations were not missing data items included in the final model. However, the conclusion was reached that both observations should be included in the analysis.

Discussion of Administrative and Instructional Variables

Since the administrative and instructional variables for the observations for fiscal year 1991-1992 were so incomplete, only the variable of part-time teaching was included in the study. Although fiscal year 1992-1993 had a complete set of items for these variables, concern as to

their relevance to this study was questioned. First, the large number of voluntary administrators, teachers, paraprofessionals, and counselors opens up the question as to whether this study or any other study could judge the effect of full-time or part-time instruction. For instance, in fiscal year 1992-1993, there were 2,999 voluntary teachers compared to only 886 full-time teachers. Even though many dedicated volunteers may be as good or better instructors than their full-time counterparts, there are no factors that indicate volunteers' quality or enthusiasm. Such a lopsided ratio toward volunteers raises several questions of teaching quality, which could not be addressed in this study. Furthermore, there were 7,671 part-time teachers with 491 part-time paraprofessionals and 190 full-time paraprofessionals who may or may not be trained to teach adults or adult education courses. Since there were so few full-time teachers, it was assumed that teaching quality in adult education is questionable and may not be verifiable.

Thus, the examination of the administrator/instructional variables was done with caution. Chances are that the success of adult education students is based less on teaching or administration than it is on the students' own characteristics, as discussed in Chapter 3.

Qualitative Reasons for Variable Selection

The variables most emphasized in this study were the variables describing the economic, social, and ethnic status

of the adult education students. Throughout much of the educational research on student achievement, the research emphasis has been on the students' social economic status (SES). Apparently, the influence of the students' background and demographics has a tremendous effect on the students' achievement in school. According to Edwards and Young (1992, September),

The importance of parent involvement in children's schooling has been a persistent theme in the research and school reform efforts of the last three decades. Studies point to higher student achievement when parents participate in school activities, monitor children's homework, and otherwise support the extension into the home of the work and values of the school" (p. 91).

Although the students in this study were adults, their parents might have influenced their motivation to earn a GED or Adult High School Diploma. The types of research that supports the importance of parental involvement include all levels of social demographics.

The influence of the father's or mother's education on the adult student appears to be undeniable. Even if the goals of parents of different educational levels are the same, their ability to help their children still differs. Epstein (1987) stated,

The main differences among parents are: their knowledge of how to help their children at home; their beliefs that the teachers want them to assist their children at home; and the degree of information and guidance from their children's teachers in how to help their children at home. These factors create more or less school-like families. (p. 135)

Another example of the problems faced by the influence of families has been revealed in the difficulties experienced in school by minority students. Several studies have demonstrated the importance of the ethnic background of the student in determining success in school. For example, according to Hyland (1992),

Currently, Hispanics have the highest dropout rate of all major population subgroups at approximately 36%, more than doubling the dropout rate of the white population. In addition, Hispanic children tend to be excessively represented in remedial tracks, to be underrepresented in gifted programs, and to exhibit low academic achievement levels overall. (p. 127)

Cibulka (1992) gave this analysis of the achievement of different ethnic groups:

Longitudinal National Assessment of Educational Progress (NAEP) data show some improvement in the scores of minority youth over time and a closing of the gap between white and minority youth. But these national trends, as Peterson (1991) points out, may mask poor performance by central city districts, an interpretation that would seem to be supported by anecdotal evidence of high minority dropout rates in central city schools. (pp. 37-38)

Thus, the importance of the student's family background appears undeniable. However, because of the nature of adult education, the variables of the different minority groups could not be tested. Too many of the observations were grouped by racial or ethnic background (i.e., Hispanic Unity). Therefore, the testing of the effects of minority status on GED success could not be tested. However, because of the presence of so many female single parents in adult

education, the variable of the percentage of the females was included.

Quantitative Reasons for Variable Selection

Before the forward selection, backward elimination, or stepwise procedures were used, the degree of multicollinearity among the variables was analyzed. If the variables were highly correlated with each other, then some of the variables would have to be either eliminated or combined. According to Chatterjee and Price (1991),

A thorough investigation of multicollinearity will involve examining the value of R^2 that results from regressing each of the explanatory variables against all others. The relationship between the explanatory variables can be judged by examining a quantity called the variance inflation factor (VIF). . . . Values of variance inflation factors greater than 10 are often taken as a signal that the data have collinearity problems. (pp. 189-191)

Again, the results supported the argument that the regression model did not have a problem of multicollinearity. Thus, the model appeared to be a good predictor of the dependent variables without multicollinearity problems. Chatterjee and Price (1991) continued by stating,

In absence of any linear relationship between the explanatory variables (i.e., if the explanatory variables are orthogonal), R^2 would be zero and VIF would be equal to unity. The deviation of VIF value from 1 indicates departure from orthogonality and tendency toward collinearity. The reciprocal of $(1 - R^2)$ also measures the amount by which the variance of the variable with other explanatory variables relative to the variance that would result if X_i were not related to them linearly. This explains the naming of this particular diagnostic. (p. 192)

An examination of the computer printout showed a VIF that was very close to unity, as can be seen by the variance inflation values given in Tables 4 and 5.

Table 4

Variance Inflation Values With Dependent Variable Y1

Variable Inflation	Description	DF	DF	Variance
X1	Enrolled in other education	1		1.19352620
X2	Students who were female	1		1.97635076
X3	Students who were handicapped	1		1.16480345
X4	Percent of legalized aliens	1		1.90371644
X5	Students in correctional facilities		1	1.73200666
X6	Students who were employed		1	1.58505721
X7	Receiving public assistance		1	1.27358665
X8	Part-time teachers		1	1.64587154
X9	Full-time teachers		1	1.78693057
X10	Costs of teacher salaries		1	2.20240015
X11	Costs of support services		1	1.14407238
X12	Costs of supplies and materials		1	1.13920911

The variance inflation demonstrated that there were no problems of multicollinearity among the variables. Since this study required two major dependent variables, an

analysis of the relationship among the variables including the total cost per student was also prepared. This relationship is presented in Table 5.

Table 5

Variance Inflation Values With Dependent Variable Y2

Variable	DF	Variance Inflation
X1	1	1.18302597
X2	1	1.98366601
X3	1	1.15601750
X4	1	1.83514954
X5	1	1.73330361
X6	1	1.57619122
X7	1	1.22614245
X8	1	1.70755591
X9	1	1.83141705
X10	1	2.11952896
X11	1	1.14209078
X12	1	1.13356466

Two major assumptions must be met when using multiple regression analysis to determine a regression model. According to Chatterjee and Price (1991), "The assumptions are (1) the explanatory variables are nonstochastic, that is, the values of the x's are fixed or selected in advance, and

(2) the x's are measured without error. These assumptions cannot be validated, so they do not play a major role in the analysis. However, they do influence interpretation of the regression results" (p. 67). Once these assumptions have been accepted, then the researcher can follow certain steps to determine variable selection.

The major procedures usually employed by researchers to develop a mathematical model for testing are the forward selection method, the backward elimination method, and the stepwise method. The first procedure that was employed in this study was the forward selection technique. In the forward selection technique, the F statistics are calculated for each of the independent variables. The variables are stated as follows:

X10--The ratio of state instructional salary expenditures over total expenditures. This was calculated by dividing the total instructional salary expenditures for each LEA cost by the total expenditures by LEA. The total expenditures included the expenditures of both state and federal monies for instructional salaries, contracted services or other personnel services, other expenses, and equipment.

X11--The ratio of state support personnel services or contracted services expenditures over total expenditures by LEA. This was calculated by dividing the total cost of other personnel services by the total expenditures by LEA. The

total expenditures included the expenditures of both state and federal monies for instructional salaries, contracted services or other personnel services, other expenses, and equipment.

X12--The ratio of state expenses of material and supply expenditures over the total expenditures by LEA. This was calculated by dividing the total cost of other expenses by the number at each LEA by the total expenditures by LEA. The total expenditures by LEA included the total expenditures of both state and federal monies for instructional salaries, contracted services or other personnel services, other expenses, and equipment. No other variables were significant at the alpha level of .05.

A summary of the forward selection procedure for the dependent variable GD and Adult High School or achievement of the GED or Adult High School Diploma is shown in Table 6. The results of the forward selection process appeared encouraging. All three of the variables which included costs were now significant for the dependent variable of Y1. These variables were then included in the model. No other variables were significant to the success on the GED examination.

The results of the forward selection procedure were that the selected variables of X12 (percentage of state expenditures on materials and supplies) and X10 (instructor salaries) and X11 (support costs) were significant when associated with the number of students passing the GED exam.

Table 6

Summary of Forward Selection Procedure for the Dependent Variable of Y1

Variable Entered/ Prob>F	Partial R ²	Model R ²	F Value-
X12 .0024	.1083	.1083	9.8399
X10 .0027	.0954	.2037	9.5872
X11 .0328	.0449	.2486	4.7190

The fact that the partial R squares for both X10, X11, and X12 were low revealed minute problems of multicorrelation, which permitted interpretation of the forward selection process without concern about the influence of the other variables. Finally, the F values for the X10, X11, and X12 variables had significance.

The backward elimination method is described by Chatterjee and Price (1991) as follows:

The backward elimination procedure starts with the full equation and successively drops one variable at a time. The variables are dropped on the basis of their contribution to the reduction of error sum of squares. The first variable deleted is the one with the smallest contribution to the reduction of error sum of squares. This is equivalent to deleting the variable which has the smallest t ratio (the ratio of the regression coefficient to the standard error of the coefficient) in the equation. If all the t ratios are significant, the full set of variables is retained in the equation. Assuming that there are one or more variables that have

insignificant t ratios, the procedure operates by dropping the variables with the smallest insignificant t ratio. The equation with the remaining ($q - 1$) variables is then fitted and the t ratios for the new regression coefficients are examined. The procedure is terminated when all the t ratios are significant or all but one variable has been deleted. (p.236)

A summary of the results of the backward elimination procedure for the dependent variable Y1 is shown in Table 7.

Table 7

Results of Backward Selection Procedure

Variable Removed	Prob>F	Partial R ²	Model R ²	F Value
X4	.9247	.0001	.2861	.0090
X9	.8044	.0006	.2854	.0618
X5	.8311	.0005	.2850	.0458
X1	.6682	.0018	.2832	.1852
X6	.6324	.0022	.2809	.2307
X8	.5893	.0028	.2781	.2940
X7	.5169	.0040	.2741	.4240
X3	.4101	.0065	.2676	.6861
X2	.1589	.0190	.2486	2.0227

The results of the backward elimination procedure reaffirmed the importance of the variables of X10 (percentage

of state funding used for instructional salaries), X11 (percentage of state funding used for other personnel services or contractual services), and X12 (percentage of state funding for materials and supplies). However, the most disappointing result was the weakness of the variable X5 or the percentage of students who were incarcerated.

Theoretically, the students in correctional institutions should have had a higher passing rate on the GED because these students are not allowed to take the GED exam until they have completed all course work. The reasons for the weakness of variable X5 are explained further in Chapter 5. However, the fact this variable had a p value of only .8311 revealed that the inclusion of X5 would have jeopardized the model's integrity and allowed for more guessing as to the actual effect or influence on the GED passing quantities.

The stepwise procedure was performed for both forward and backward selection (elimination). Agresti and Price (1986) wrote,

The stepwise regression procedure is a modification of the forward selection procedure that drops variables from the model if they lose their significance as other variables are added. The general approach is the same as in the forward selection procedure except that at each step, after entering the new variables, we drop from the model any variables whose partial contributions are no longer significant. With this procedure, a variable entered into the model at a particular stage may eventually be eliminated because of its strong relationship to other variables entered at later stages. (pp. 378-379)

The results of the stepwise method for the dependent variable GD or the acquisition of the GED and Adult High School Diploma are shown in Table 8.

Table 8

Results of the Stepwise Method for the Dependent Variable Y1

Variable Entered/ Prob>F	Partial R ²	Model R ²	F Value
X12 .0024	.1083	.1083	9.8399
X10 .0027	.0954	.2037	9.5872
X11 .0328	.0449	.2486	4.7190

Again, the stepwise procedure confirmed the results of both the forward selection and backward elimination procedures. Obviously, the X10, X11, and X12 variables should be included in the final model with the dependent variable Y1 or the number passing the GED or earning the Adult High School Diploma.

Evaluation of the Selection Procedures
and their Results

In order to select the proper variables needed in the model, theoretical significance to the model must be

determined. In other words, common sense, past research, or sometimes just plain guessing may be used to determine the variables that should be included in the model.

Finally, researchers do not always agree on which method is best at determining the proper model. For example, many researchers believe the backward elimination method is superior to both the forward selection method and the stepwise procedure. Chatterjee and Price (1991) commented,

We recommend the BE [backward elimination] procedure over the FS [forward selection] procedure for variable selection. One obvious reason is that in BE procedure the equation with the full variable set is calculated and available for inspection even though it may not be used as the final equation. Although we do not recommend the use of stepwise procedures in a collinear situation, the BE procedure is better able to handle multicollinearity than the FS procedure. (p. 237)

Since the variables appeared not to reveal multicollinearity, the stepwise procedure was believed to be the appropriate method to determine the best variables and their corresponding parameter estimates. Furthermore, the backward elimination method was used to monitor the variables entered into the stepwise approach. However, even by using all three of the methods, the researcher's judgment will always affect interpretation of the results.

There is a need to consider theoretical possibilities and to choose the best method of variable selection; however, the major purpose of this study was exploratory. However, Agresti and Finlay (1986) stated, "The goal is not to explain relationships among variables so much as it is to find a good

set of predictors" (p. 380). This study was designed to predict the optimized costs of adult education funding in Florida. Therefore, the selection of a combination of variables that appeared to be important and most significant to the study was believed to be the best procedure.

The results from the stepwise procedure were surprising. The absence of variable X5, or the percentage of incarcerated participants, nullified the argument that the sometimes mandatory enrollment in GED or Adult High School programs was a major factor in the success of these participants. All GED students cannot be thrown in jail for the sake of education, and there is little evidence as to success rate of mandatory programs external to state correctional facilities.

The variable X11, which related the total costs per student of other personnel or contractual services, was important in the model. The costs of paraprofessionals and teachers' aides may play an unseen benefit toward success in adult education. One adult education administrator commented that many classes may be "taught" by a paraprofessional or an absent teacher with the help of self-study workbooks. The state mandate that all adult education teachers be certified may look good on paper, but the reality is that adult education teaching is made up of an assortment of part-timers, volunteers, and whoever-may-be-interested-in-teaching

types of personnel. The reader may only contemplate as to the quality or presence of teaching.

Thus, the results of the study point to the three main variables of instructional salaries, other personnel services, and the costs of other expenses of supplies and materials. The question remains, however, as to how to deal with the other variables that remained unselected. The obvious explanation may be that the connection or relationship of many of the variables was either nonexistent or weak at best. Because of the extreme dropout rate experienced in adult education (over 40%), any success with passing the GED would seem a high achievement. Furthermore, the weakness in the data may reflect the complexity of dealing with adult students rather than children in pre-K through 12. Adults may have their own agenda, and only a minority of enrolling adult education students have the GED or Adult High School Diploma as a goal. The reasons are many. Some want to learn to read only simple sentences or just read the Bible. Others are there because their friends are enrolled. Whatever the reasons, the variables selected could be improved with some method of accurately determining the reasons why some leave and why some stay. Other reasons for the weakness in the variable relationship might be due to the lack of available data. Although this study was a population study, many of the local education agencies were

not listed. The agencies which were not listed may be found in Appendix D.

Determination of Significance of Variables in Model

The second major step in the study was to determine the significance of the selected variables to the regression model. Thus, the PROC REG procedure in SAS was invoked for the regression model of $Y1 = X10 + X11 + X12$ (Table 9).

Table 9

Results of Applying Model $Y1=X10, X11, X12$ on SAS System

Source	DF	Sum of Squares	F Value	P Value
Model	3	.08652	9.021	.0001
Error	83	.26535		
Total	86	.35188		
R square	.2459			
<u>Variable</u>	<u>DF</u>	<u>Parameter Estimate</u>	<u>T value for Ho:</u>	<u>P</u>
Intercept	1	.027077	1.922	.0581
X10	1	.061260	3.122	.0025
X11	1	.206600	2.219	.0292
X12	1	.192165	3.389	.0011

Since the above model could be improved, a continued investigation was made of nonlinear and curvilinear formulations, such as adding quadratic artificial variables or adding interaction variables to reflect the effects of

the interaction of the variables. The results of developing quadratics were disappointing. Many of the quadratic formulations may have increased overall R square and the F value, but they left the parameters of the variables themselves insignificant. Furthermore, the use of quadratics beyond the third power is usually not helpful in social research modeling. However, attempts were made to develop a quadratic formula for the variables X10, X11, and X12. The tests of interactions were not promising either. By including an artificial variable representing the square of the interaction between the two selected variables, the R square was improved but the significance of the parameter estimates allowed p value of much higher than the acceptable .05. Thus, the final model that was determined for the analysis of the first dependent variable of GED and Adult High School is as follows:

$$Y1 = .027077 + .061260 * X10 + .206600 * X11 + .192165 * X12.$$

The results of running the above model using the SAS system proved fruitful. Some of the attempts at improving the model's fit may be examined in Table 10. However, as can be seen from the results, the best model that could be obtained was the one stated above.

The data in Table 10 reveal that the R-square was increased by including the interaction of variables X10 and X12. However, the t value and the probability of the

Table 10

Results of Applying Model on SAS System

Source	DF	Sum of Squares	F Value	Prob > F
Model	4	.09983	8.120	.0001
Error	82	.25204		
Total	86	.35188		
R square	.2837			
<u>Variable</u>	<u>DF</u>	<u>Parameter Estimate</u>	<u>T Value for Ho:</u>	<u>P</u>
Intercept	1	.023937	1.722	.0888
X10	1	.083046	3.792	.0003
X11	1	.177412	1.921	.0582*
X12	1	.509796	3.138	.0024
X10 * X12	1	-.711330	-2.081	.0406

parameter estimate of X11 exceeded the .05 significance level. Therefore, the increase in R squared was not large. The significance of the increase in R squared was tested using the equation as follows:

$$F = \frac{(R_{FULL}^2 - R_{RED}^2) / (df_{FULL} - df_{RED})}{(1 - R_{FULL}^2) / df_{ERR_F}}$$

$$F = \frac{(.2837 - .2459) / 1}{(1 - .2837) / 82} = \frac{.0378}{.008735} = 4.327$$

3.96 = F significant

The F statistic of 4.327 was significant. However, the interaction of variables X10 and X12 were omitted from the final model. After examining the data using Cook's D for X10, X11, and X12, three observations were found to have standard deviations greater than 2.00. Although these observations did not have standard deviations of greater than 3.00, these observations might have been potential outliers. Therefore, observations 44, 56, and 65 were omitted from the analysis. After deleting the above-mentioned outliers, the interaction of X10 and X12 were found to be no longer significant as follows:

X10 * X12 T for Ho = -1.909, Prob>T = .0599

Upon returning to the final model, at first glance, the results of the model on the SAS system revealed a rather unuseable model, considering the weakness of the R squared statistic. However, certain aspects of the model should be discussed. First, the model reflects the strong emphasis on variable X12 since the parameter estimate and significance to Y1 was very strong. Furthermore, the model had an F value of 9.021 and was therefore useable for testing purposes.

Tests of Partial Correlations of the Model's Variables

Once the final model was selected, a test of the Squared Semipartial Correlation Type II was prepared, and also prepared was a test of the Squared Partial Correlation

Type II. The analysis of these partial correlations is presented in Table 11.

Table 11

Partial and Semipartial Correlations

Variable	DF	Squared Semipartial Correlation	Squared Partial Correlation
X10	1	.08857093	.10510575
X11	1	.04473449	.05599878
X12	1	.10432154	.12152533

The semipartial and partial correlations did not reveal a problem of multicollinearity. Therefore, the model must be a good representation of the relationship with the GED exam.

Problems of Determining Funding

The funding of adult education programs was difficult to trace. Although most of the funding was through the pre-K through 12 Florida Education Finance Program (FEFP) or the Community College Program Fund (CCPF), much of the funding at the remote sites--such as Hispanic Unity, the Urban League, or volunteer organizations--came from federal funds or donations. Because information concerning the donations was difficult to trace or unavailable, these monies were ignored in the analysis. However, an attempt to examine the costs of federal funding was done in order to examine the

influence of this funding. One must realize, however, that the bulk of the federal funding made up only 3.7% of the total funding for adult education. Many organizations received donations which exceeded their federal grants. Thus, the examination of federal grants must be done with some reservations.

As was discussed in Chapter 3, the same 12 variables were used in forward selection, backward elimination, and stepwise methods while using the total cost per student as the dependent variable (Y2). The results are shown in Table 12.

Table 12

Results of the Forward Selection Process

Variable Entered/ Prob>F	Partial R ²	Model R ²	F Value
X9 .0001	.2672	.2672	29.5319
X1 .0227	.0464	.3135	5.4021
X5 .0317	.0392	.3527	4.7832

The results revealed that the variables X9 (percentage of full-time teachers), X1 (percentage of participants who were in other educational programs), and X5 (percentage of

participants who were in correctional institutions) were most significant with the dependent variable Y2. The explanations for this are unclear. The reasons these variables were significant are discussed in more detail in Chapter 5. However, the fact that full-time teachers are paid greater salaries in addition to benefits might explain the presence of variable X9. Also, the FEFP does allow for greater allotments for handicapped students. Perhaps these findings demonstrate that the changes in funding are related to these types of participants.

The presence of variable X5 is not surprising. Since this variable was fairly strong in its significance in the regression using the GED and Adult High School Diploma, it seemed to remain strong when funding was a consideration. More funds were spent on education of individuals in correctional facilities than for the general public.

The results of the backward elimination procedure supported the results of the forward selection method. These results are presented in Table 13.

Again, the backward elimination confirmed the final result of the forward selection procedure. With only the variables of X1, X5, and X9 remaining in the model, the stepwise procedure resulted in the same conclusion. The results of the stepwise procedure are displayed in Table 14.

Table 13

Results of the Backward Elimination Procedure

Variable Removed	Prob>F	Partial R ²	Model R ²	F Value
X11	.9135	.0001	.3940	.0119
X2	.6953	.0013	.3926	.1547
X10	.6731	.0015	.3911	.1794
X7	.5505	.0030	.3881	.3597
X8	.5154	.0035	.3846	.4271
X12	.4185	.0054	.3792	.6618
X6	.4356	.0050	.3741	.6142
X4	.4869	.0040	.3702	.4881
X3	.1456	.0174	.3527	2.1602

Table 14

Results of the Stepwise Procedure

Variable Entered/ Prob>F	Partial R ²	Model R ²	F Value
X9 .0001	.2672	.2672	29.5319
X1 .0227	.0464	.3135	5.4021
X5 .0317	.0392	.3527	4.7832

The results demonstrated the same final variables. However, one may note that the X5 variable made only a weak contribution to the final model for dependent variable Y2. The weakness of this variable in being significant to the analysis may be seen by the results of the model developed by the SAS system, as shown in Table 14.

Test of Partial Correlations and Analysis of Final Model

Another test of the partial correlations for the model with the dependent variable Y2 (total costs per student) was prepared. The results of this test are also presented in Table 15.

Table 15

Partial and Semipartial Correlations

Variable	DF	Squared Semipartial Correlation	Squared Partial Correlation
X1	1	.06057333	.08557391
X5	1	.03919084	.05709076
X9	1	.32254306	.33258107

The semipartial and partial correlations did not reveal a problem of multicollinearity. Even though the partial and semipartial correlations were high for variable X9 (above .30), they were not high enough to justify the exclusion of X9 from the proposed model. Therefore, the model must be a

good representation of the relationship with the total costs per student.

The variable X5 was retained in the analysis. The final model for the dependent variable Y2 was as follows:

$$Y2 = .426911 - 1.131003 * X1 - .89414 * X5 + 1.949522 * X9.$$

The results of the analysis of variance are shown in Table 16. The R squared of .3527 was fairly high considering the circumstances surrounding adult education. From past experience with the variables, it was difficult to discover any variables that showed a strong relationship with either the dependent variable Y1 or Y2. The parameter estimates are shown in Table 16.

After the variables had been selected with the above-mentioned procedures, scatter plots of the residuals and studentized residuals were plotted against each of the variables thought to be critical in determining student GED achievement.

Examination of the scatter plots of residuals and studentized residuals against the independent variables and predicted dependent variables revealed a fairly strong model. The plots are fairly evenly scattered, which would infer that the independent variables are not additive and that there is an absence of multiplicative or interaction effects. The scatter plots of the residuals and studentized residuals

Table 16

Results of the Model Developed by the SAS System

Source	DF	Sum of Squares	F Value	P
Model	3	7.56649	14.350	.0001
Error	79	13.88503		
Total	82	21.45152		

R Squared = .3527

<u>Variable</u>	<u>DF</u>	<u>Parameter Estimate</u>	<u>T Value for Ho:</u>	<u>P</u>
Intercept	1	.426911	5.837	.0001
X1	1	-1.131003	-2.719	.0080
X5	1	-.894140	-2.187	.0317
X9	1	1.949522	6.274	.0001

plotted against the dependent variables Y1 and Y2 reveal a movement from left to right in an upward direction. This result would be expected since variables Y1 and Y2 should increase with the increase in residuals.

The following two equations were then solved simultaneously using the pertinent constraints:

Maximize:

$$Y1 = .027077 + .061260 * X10 + .206600 * X11 + .192165 * X12$$

Subject to:

$$O1 \geq .426911 - 1.131003 * X1 - .89414 * X5 + 1.949522 * X9$$

$$O1 = (\$228,606,358.00 + \$634,768.00) / 100,000,000$$

The \$228,606,358.00 was the total expenditures for adult education for fiscal year 1992-1993, and the \$634,768.00 was the total expenditures for LEA C, LEA D, LEA E, and LEA F.

The following constraints were utilized:

$$.08 \leq X1 \leq .10$$

$$.05 \leq X5 \leq .15$$

$$.05 \leq X9 \leq .10$$

$$0 \leq X10 \leq .98$$

$$0 \leq X11 \leq .39$$

$$0 \leq X12 \leq .60$$

$$0 \leq X10 + X11 + X12 \leq 1.00$$

These constraints were determined by examining the typical magnitudes of the variables in real life. For example, the prison population (X5) should not exceed 15% of the total participants. Finally, the variable X9, or the total percentage of full-time teachers, will probably not exceed 10% of the total teaching staff of the LEA. The material given in Table 17 clarifies the decision to select the above-mentioned constraints.

Table 17

Support for the Constraints

Description	Fiscal Years			
	1989-90	1990-91	1991-92	1992-93
Percentage in other programs	8.0834	6.1184	8.836	9.617
Percentage of students in prison	12.3936	11.4933	8.007	8.965
Percentage of full-time teachers	7.2852	7.6046	6.625	6.969
Range of Percentages				
Percentage of cost of instructional salaries (X10)		0	.9767897092	
Percentage of cost of services (X11)		0	.388105579	
Percentage of cost of other expenses (X12)		0	.602050413	

Results of the Solution of Simultaneous Equations

The mathematical program of Mathematica was used to solve the equations simultaneously. According to Wolfram (1991), "Mathematica can solve any set of simultaneous linear equations. It can also solve a large class of simultaneous polynomial equations. Even when it does not manage to solve

the equations explicitly, Mathematica will still usually reduce them to a much simpler form" (p. 97). Since the variables in the above equations were not repeated, Mathematica in essence would only combine the equations by altering the parameter estimates in reaction to the individual variables.

A specific model using simultaneous equations was difficult to determine. According to Hillier and Lieberman (1974), "If the rank of A [total number of equations] is less than n [total number of unknowns], then there will exist an infinite number of solutions" (p. 766). Since the above two equations for variables Y1 and O1 did not share any common variables, the solution of these two equations would be considered meaningless. Since the equation for O1 could not be used as a constraint for the equation for Y1, there is no budgetary or cost constraint for the maximization procedure. Therefore, there was not a specific simultaneous solution available for the two equations. According to Wolfram (1991), "There are some equations, however, for which it is mathematically impossible to find explicit formulas for the solutions" (p. 96).

The possible use of the first equation might be to give the budgeting officer an allocation method which results in the greatest success for the adult education student. This first model is restated as follows:

$$Y1 = .027077 + .061260 * X10 + .206600 * X11 + .192165 * X12.$$

The possible uses of the above-stated equation are discussed in Chapter 5.

Summary

Twelve variables were used in the multiple regression analysis. Of these 12 variables, the variables that had the greatest effect on student success with the GED were the state's expenditures on teacher salaries, the costs of other support services, and the costs of materials and supplies. Furthermore, three variables were found to be significant statistically to the increase in cost of adult education. These variables were the percentage of full-time teachers, the percentage of students involved in other educational programs, and percentage of students who resided in correctional facilities. Since the variables which affected success on the GED did not coincide with the variables that affected total costs of adult education, a specific solution using simultaneous equations was not meaningful or possible. However, the study did conclude that the use of the formula developed from success on the GED may be useful for determining the proper allocation of funds.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

Introduction

The purpose of this study was to develop and analyze a mathematical model to optimize the funding for adult education programs in Florida. Although a simultaneous solution of linear and nonlinear formulations was attempted, the solution of the two equations was not possible. Therefore, the development of a comprehensive model that encompassed the variables that affected both the success rate of the GED or Adult High School Diploma and the total costs per student was not possible. However, the first equation representing the relationship of the variables to the GED and Adult High School Diploma may be used to estimate the percentage allocations of the separate spending categories of adult education funding. For example, the final equation developed from multiple regression techniques was as follows:

$$Y1 = .027077 + .061260 * X10 + .2066 * X11 + .192165 * X12.$$

The above model could be used to estimate the allocation of the categories of instructor salaries (variable X10), other personal services or support costs (variable X11), and

the costs of other expenses or instructional supplies (variable X12). Thus, a state agency could use the above formula to allocate the above costs based on the parameter estimates. However, one word of caution must be made. The above equation, which had an R squared of only .25, was considered low for prediction purposes. Therefore, the weakness in the correlation of the model to the success factors would need to be included in any budgeting process before a final funding allocation was initiated.

Problems and Limitations of the Study

Unforeseen difficulties were encountered during the execution of the study, the most troublesome of which was the occurrence of missing or incomplete data. In addition to the 6 observations that were omitted because of missing data for the independent variables and the 1 observation omitted because of the missing dependent variable, 14 observations did not have complete data for the variables of X10 (state instructional costs), X11 (state support costs), and X12 (state supply and material costs). These 14 observations were funded solely by federal monies or outside donations from charity organizations. Since there was no state funding of these 14 LEAs, the variables of X10, X11, and X12 were assumed zero for all of these observations. However, the final results of the multiple regression might not have been representative of these variables because of these omissions. Because the state cannot control the amount or categorical

distribution of federal dollars or contributions, the forcing of these variables to equal zero was unavoidable. Thus only the county districts and community colleges could demonstrate the actual magnitude of variables X10, X11, and X12.

One variable that could have been included in the study was the variable of the percentage of minorities for each LEA. Unfortunately, due to the nature of adult education, many of the LEAs were unintentionally segregated by race and ethnic group because of the demographics of society. Since most adult education centers attempt to offer courses in locations where the courses are needed, many local LEAs were representative of only one minority group such as Hispanics for the Hispanic Unity organization, etc. Thus the inclusion of the variable of minorities would have allowed for too few observations for regression analysis. If the data had been arranged to accommodate the different ethnic groups, then this variable could have been included. Finally, the fact that the minority students made up a majority of the student body caused the information gained from such a variable to be of little value.

Other difficulties were also revealed when the regression equation involving the dependent variable of total cost per student was analyzed. Four of the community colleges share the costs for adult education for four of the reported districts. However, these colleges did not report any statistics for adult education. Instead, the county

districts reported the actual adult education statistics for the colleges. The unreported community colleges and their respective county districts are shown in Table 18.

Table 18

Unreported Community Colleges and their Respective County Districts

Community College	County School District
Santa Fe	Alachua County
Miami-Dade	Dade County
Seminole	Seminole County
Hillsborough	Hillsborough County

The only solution available to solve this reporting problem was to add the costs of the community colleges to those of the districts and use the combined totals for analysis.

The other major problem encountered in this study was that a true GED passing rate was not available per LEA on a fiscal year basis. No statistics were available as to how many of the adult education students who actually sat for the GED exam actually passed. Since the GED exam was designed to enable the student to pass regardless of whether the student had taken any of the adult high-school-level courses, the percentage of the total students enrolled in adult education was considered relevant to the study. Furthermore, since the GED as a success factor was considered equivalent to the

Adult High School Diploma, the percentage of all adult education students who had earned the Adult High School Diploma was also considered a valid success factor for this study. Of course, the limitations of such assumptions might have affected study results. To be sure, there may have been students who had attended only a GED prep course and passed the GED exam in one calendar year. Furthermore, some students had repeated several grades and had attempted the GED several times without success. Finally, some students may have taken the exam several times and passed only in the fiscal year in which the study was made. Thus, with all these reservations, a GED passing rate may not have been any more valid than the percentage of the total student body that had achieved these goals.

Other difficulties dealing with the costs related to the Department of Corrections were encountered in the study. Since the Department of Corrections was treated as one observation, all of the individuals in this observation were included in variable X5, or those students who were in correctional facilities. Attempts at excluding this observation were futile because more than 25% of the total number of individuals in correctional facilities were included in this one observation. Thus this observation was included in the analysis. These costs were not available by category for the variables of X10, X11, and X12.

The observations that included Native American (Indian) tribes did not indicate the exact allocation of costs for variables X10, X11, and X12. However, upon advice from Department of Education staff, these costs were allocated to the variable X10, or the total costs of instruction.

By eliminating the observations of LEAs that received no state dollars and by eliminating any community college that had received federal dollars, an alternative analysis was obtained. This analysis involved the regression of the controllable variables of X10, X11, and X12 against the dependent variable of GED and resulted in a fairly usable model for funding only these entities. Also, the federal costs of one district were added to one community college observation because of lack of information.

The final concern that many observers of this study would be quick to point out is the problem of definition of the separate categories for variables X10, X11, and X12. Although the definitions of instructional salaries for the community college, school districts, and other not-for-profit agencies were similar, the treatment and magnitude of fringe benefits were very different. The districts appeared to have the most costs related to teacher benefits. However, at the other extreme, the not-for-profit agencies had the least benefits. The effects of these differences on the data were uncertain and need to be studied further. Again, the definitions of the other personnel services were similar, but

the use of these temporary staff members ranged from office work to support as teachers' aides. The differences in these allocations were considered nonconsequential. Finally, the differences in the allocation of other expenses and equipment purchases were confusing. Regardless of the determination of whether costs should be considered equipment or expense, the final results were probably unaffected by these decisions.

Concluding Remarks Concerning the Mathematical Model

The results of the multiple regression of the 12 independent variables with the dependent variable of the GED were not surprising. The variables of X10 (the percentage of state adult education costs spent on instructional salaries), X11 (the percentage of state adult education costs spent on other personnel services or support services), and X12 (the percentage of state funding designated for materials and supplies) were the only variables found to be significant. The variables will be discussed in order of their significance to the passing of the GED exam or the achievement of the Adult High School Diploma.

The relationship of variable X12 (the percentage of state funding that was contributed to materials and supplies) and the GED may be explained by observing the typical organization of the adult education facility. Because of high student-teacher ratios (sometimes exceeding 60 to 1), many LEAs have resorted to using certified teachers combined with paraprofessionals. Because of this inadequacy, many

adult educators have turned to the "workbook approach" to education. The teacher acts as an overseer by helping the students complete workbooks on an individual or independent basis. Finally, the course materials of many of the GED preparation courses and similar programs of instruction make liberal use of study guides, workbooks, and sample tests in order to teach the students how to pass the GED.

Variable X10 (the percentage of state funding spent on instructional salaries) appeared next in importance in the model. The presence of X10 confirmed the position that the cost of instructors in adult education was a major factor in success in adult education. Although the cost of instruction was secondary to the costs of materials and supplies, the need for individuals to guide the studies of these adults was most evident. However, the determination of whether emphasis should have been placed upon part-time or full-time instructors was not determinable. The variables X8 (percentage of part-time teachers) and X9 (percentage of full-time teachers) were not significant and were eliminated from the model. Perhaps future studies could help answer these questions.

The need for teachers has presented itself in several studies.. The existence of variable X11 (the percentage of state funding spent on other contractual services) may be due to the fact that so many of the support staff helped in the instruction of the students in adult education. As stated

earlier, because the teacher-to-student ratio was low, as compared to pre-K through 12 or even higher education, the presence of support personnel may be pertinent to the success or achievement of the adult education student.

The purpose of this study was not to judge the quality of the above approaches toward adult education instruction. However, the importance of materials and supplies in the study of adult education will be more and more appreciated.

Unfortunately, the study did not encompass the effect of equipment purchases on the performance of adult education students. Since these costs made up only 5% of the total costs of adult education, they were ignored in the study. However, as education moves from a paper-based textbook-workbook approach to a paperless system of self-paced computer programs, these equipment costs may be much more important to the determination of the number of students passing the GED or earning the Adult High School Diploma.

Discussion of the Variables of the Cost Model

The results of the second model involving the total cost per student as the dependent variable were also easily explained. The second model may be stated as follows:

$$Y2 = .426911 - 1.131003 * X1 - .089414 * X5 + 1.949522 * X9$$

The independent variable X9 (percentage of full-time teachers) contributes significantly to the total costs of

educating students. Payment of full-time teachers requires not only higher wages than those earned by part-time teachers or volunteers but also includes payment of fringe benefits. The fringe benefits of the districts alone make up almost 30% of the total salary costs for instruction. Any increase in full-time teachers would result in large budget increases for teaching adult education students with limited results in passing the GED or earning the Adult High School Diploma.

The variable X1 (percentage of students in other educational programs) may be explained by the relationship adult education has with other academic programs in the state. Many individuals who pursued the GED or Adult High School Diploma were not greatly involved in other state-sponsored programs, such as vocational education in the many vocational centers across the state and community college programs leading to certificates in vocational or academic disciplines. Thus the negative relationship of the variable X1 revealed that Adult Education programs were experiencing some economies of scale by offering more adult education programs and, therefore, reducing overhead costs associated with each student. Certainly, the legislature's emphasis on the current proposal for the Enterprise Florida program is evidence of the importance of the goal toward gainful employment of Florida's residents.

The variable X5 (percentage of students in correctional facilities) was also revealing. The strength of the

relationship of this variable to the total cost per student should have been positive because more funds are spent on the adult education of prisoners than are spent on the general population. Regardless of the fairness of this fact, state law guarantees residents access to a high school education. Because so many prisoners may be required to sit in GED preparation courses to satisfy judicial requirements, these students are provided more funds to meet statutory requirements. However, because of the negative parameter estimate, the above relationship was not realized.

Conclusions and Remarks

The results of the study point toward the need to place more funding emphasis on support materials and instructional supplies for adult education. These recommendations were found in other studies on adult education. Porter and Kissam (1990, July 23) stated, "This value-added approach has reportedly influenced the type of curricula taught, the way curricula are implemented, and the frequency and content of ancillary support such as faculty advising. It has helped generate pressure for more resources for students deficient in skills, and more remediation" (p. 25). Review of the several models reveals the positive benefits of competency-based learning, incentive programs for improving learning deficiencies, and promotions for program improvements. Porter and Kissam (1990) concluded with a rather positive view of a nontraditional approach to adult education. They

stated that instruction should allow for "any-time, any-place, and on-demand" instruction. For instance, adult education programs should have computer-assisted instruction and televised courses, tutoring and on-the-job training, and collaborative programs with businesses and manufacturers. Porter and Kissam (1990) also listed the following recommendations:

Adopt the Independent Study Approach as the Basis for Non-traditional Adult Education.

Develop A Cafeteria Plan of Reimbursement Options.

Develop a Statistically Reliable Model for Measuring Increased Learner Competencies.

Develop a Fee-for-services Incentive Model.

Develop a Standardized Funding Model Based on Value-Added.

Experiment With a Cafeteria Plan of Reimbursement Options. (p. 75)

Suggestions for Further Research

The statistical weakness of the final equation for the success of the GED and Adult High School Diploma points to the need for further investigation. Although it appears that the costs of instruction (variable X10), support services (variable X11), and other expenses (variable X12) were important to success, the low R squared was somewhat disappointing. However, the study could be repeated under the following circumstances:

1. The study should be performed in a state that records data by LEAs where there are more LEAs than this

study's 85. Many states have more than 150 different school districts which might provide the means to increase the number of observations available to the researcher, resulting in more estimates.

2. The inclusion of a variable recording the costs and/or depreciation of electronic equipment (i.e., computers) used to assist in teaching. Unfortunately, for the purposes of this study, this information was either unavailable or the local LEA did not have much electronic equipment.

3. The need to examine the effects on achievement of different ethnic or racial groups should be included in future studies. There were too few observations to use for this variable. However, a better organized data base might allow for this investigation.

4. The investigation of the differences in achievement among the three major LEAs could be examined in future studies. For example, the three major types of LEAs were the school districts, the community colleges, and the not-for-profit agencies supported by federal grants and other donations. By investigating the differences in achievement among these groups, different states could determine which type of LEA would be most successful in achievement of the GED or the Adult High School Diploma.

5. An emphasis on the study of adult education curriculum should be made. The advantages or disadvantages of GED prep courses versus traditional GED or adult high

school courses should be studied. The benefits of these different approaches would be helpful in determining the final allocation of adult education funding.

6. One further avenue of research would be to divide the funding into different levels. For instance, because of the existence of many unpaid volunteers and smaller LEAs, the amount of funding ranged from a high of \$3,000 per student down to approximately \$75 per student. Another study that allows for the division of the funding into different levels would be very useful for determining future funding. Hager (1994), the codirector of the Center for Applied Optimization at the University of Florida, recommended this approach for future studies.

Final Conclusion

The presentation and analysis of the data and the resulting recommendations were an attempt to quantify the successes of adult education. The critical need for an educated populace cannot be refuted. If the United States is to continue to compete in a global economy, more studies should be pursued in an attempt to maximize student success and educate a more trainable society.

APPENDIX A
PRESENTATION OF RAW DATA

LEA	GED	AHS	MALE	FEMALE
01	0	0	18	48
02	56	4	1213	1580
03	86	0	168	221
04	65	37	795	1037
05	88	0	232	272
06	853	186	3566	3315
07	3160	37	30011	35085
08	12	0	198	309
09	12	16	51	90
10	262	0	578	857
11	71	14	449	431
12	6	0	25	73
13	210	12	727	1056
14	5	0	52	73
15	404	0	3203	2913
16	54	3	206	309
17	1117	0	9370	660
18	3024	546	54898	63411
19	1161	109	4451	3475

20	39	0	405	363
21	140	38	1424	1451
22	57	50	212	279
23	682	202	9467	9919
24	28	8	62	116
25	19	0	516	492
26	10	0	27	45
27	.	.	.	.
28	4	9	125	145
29	2	0	64	85
30	42	0	253	269
31	47	2	399	244
32	133	1	967	1307
33	0	0	92	23
34	1897	220	13570	14591
35	0	0	62	92
36	382	37	5823	5817
37	108	0	450	431
38	57	2	559	554
39	0	0	102	80
40	20	1	129	230
41	16	0	76	64
42	59	0	116	214
43	80	19	493	661
44	666	4	1361	1521
45	2	0	162	202

46	300	15	2746	3190
47	6	5	142	176
48	10	2	69	57
49	1	2	71	49
50	2	0	29	28
51	331	8	1834	1690
52	217	24	844	1096
53	159	1	1242	973
54	2	0	20	24
55	189	0	416	493
56	310	0	566	600
57	0	0	74	70
58	20	0	171	266
59	39	0	126	241
60	69	0	280	954
61	11	0	57	66
62	1743	66	19600	10459
63	344	2	1245	1408
64	0	0	126	119
65	374	0	11361	12054
66	761	28	2643	3572
67	147	221	1863	1984
68	923	25	6776	8626
69	344	21	2895	4203
70	49	3	544	537
71	521	29	1873	1805

72	734	143	1923	2436
73	4	0	27	36
74	203	38	1305	1632
75	151	9	510	424
76	122	1	513	623
77	40	0	151	162
78	1	2	84	143
79	0	0	64	139
80	15	5	24	108
81	31	8	220	286
82	7	0	38	44
83	46	0	174	276
84	4	8	63	52
85	54	0	131	288
86	32	0	262	112
87	.	.	.	.
88	0	0	26	0
89	.	.	21	32
90	0	0	12	23

LEA	EMPLOYED	UNEMPLOYED	ON PUBLIC ASSIST.	HANDICAPPED	LIMITED ENGLISH	RURAL
01	26	25	0	0	6	0
02	533	2260	0	206	404	177
03	125	264	47	60	0	0
04	337	1495	186	145	266	38
05	187	317	92	80	1	504
06	3165	3715	310	365	606	268
07	15701	44946	2385	1734	20971	0
08	232	275	200	0	181	0
09	29	112	0	13	1	136
10	205	1230	0	73	210	0
11	140	740	0	152	0	671
12	12	86	98	1	8	0
13	1088	695	8	20	218	141
14	73	52	39	0	108	125
15	5571	4723	128	185	1144	774
16	74	441	146	85	15	292
17	0	0	0	0	0	0
18	17124	101185	124	4487	56208	.
19	2378	5548	317	623	547	476
20	178	590	0	285	119	0
21	1182	1693	100	182	82	318
22	173	318	0	59	21	42
23	9150	12031	2906	1300	2007	0
24	49	129	0	9	0	108

25	34	974	0	334	26	627
26	12	60	0	0	0	0
27	.	.	.	.	.	.
28	107	163	0	31	0	225
29	31	118	21	0	0	149
30	202	320	0	32	50	0
31	313	330	0	0	314	324
32	525	1749	128	201	51	0
33	92	23	60	0	115	115
34	12724	15437	0	921	4043	1128
35	0	42	0	0	154	0
36	2194	9446	684	81	1763	1127
37	373	508	153	21	173	207
38	220	893	0	544	18	583
39	136	46	9	15	3	.
40	0	359	0	0	0	70
41	18	122	0	0	29	74
42	77	253	12	0	0	330
43	359	795	50	49	7	115
44	1113	1089	0	179	543	0
45	102	35	0	20	141	26
46	1711	4225	106	1055	314	0
47	166	152	0	41	0	171
48	0	126	0	0	0	21
49	101	19	0	2	88	0
50	0	0	0	0	13	46

51	1219	2305	10	124	968	13
52	128	1775	0	172	119	71
53	693	1522	0	142	725	1
54	4	40	18	0	6	44
55	0	904	0	42	238	0
56	453	713	181	74	10	1111
57	80	64	30	29	80	143
58	218	219	121	105	2	437
59	91	276	0	0	135	0
60	463	862	299	21	343	252
61	27	96	0	30	13	0
62	12032	21612	4646	1432	6359	219
63	764	1889	0	183	781	17
64	143	102	0	22	0	37
65	6062	17353	726	701	13239	1640
66	1659	4556	0	211	126	5219
67	563	3129	541	328	375	1419
68	6245	9157	70	2833	2513	2
69	1358	5740	0	2514	818	0
70	201	880	108	55	10	216
71	1077	2601	0	183	781	38
72	1656	2703	959	218	1437	262
73	24	39	0	0	19	41
74	2203	734	1322	206	657	2937
75	375	1029	0	156	100	0
76	272	728	0	115	50	1136

77	45	268	0	29	1	313
78	66	161	0	4	0	61
79	146	27	8	0	0	0
80	22	42	25	0	0	10
81	456	250	146	0	0	506
82	39	43	0	0	0	58
83	98	192	150	95	91	194
84	50	65	0	0	0	115
85	102	317	187	38	2	369
86	46	328	182	23	6	53
87	.	.	.	.	.	.
88	0	26	0	0	0	0
89	21	.	.	3	14	53
90	10	20	2	0	0	35

LEA	IN CORR. FAC.	IMMIGRANT	OTHER INST.	LEGAL ALIEN	HOMELESS	OTHER EDU.
01	0	6	0	0	0	10
02	77	0	52	3	0	567
03	0	0	9	0	0	38
04	0	0	56	0	0	258
05	0	0	0	0	0	17
06	193	41	2	124	27	247
07	5449	2336	1331	1317	727	4202
08	0	0	0	181	0	0
09	0	0	0	0	0	82
10	13	5	0	5	0	59
11	0	0	18	0	0	201
12	0	0	0	0	0	5
13	0	0	0	0	0	371
14	0	51	0	47	0	26
15	122	325	0	634	0	139
16	0	5	0	0	0	0
17	10030	0	0	0	0	0
18	2460	35184	1750	2066	1649	6091
19	2457	507	0	41	0	72
20	0	0	0	0	0	68
21	141	21	10	6	0	944
22	2	0	0	1	0	113
23	1967	635	1552	572	247	1199
24	0	0	0	0	0	0
25	0	0	237	0	0	34

26	0	0	0	0	0	16
27	.	.	.	.	.	.
28	0	0	11	0	0	13
29	0	0	0	0	0	29
30	0	0	0	0	0	31
31	1	12	0	82	0	21
32	129	0	0	0	0	520
33	0	114	0	38	20	1
34	4189	25	439	5	0	4280
35	0	0	0	0	0	0
36	129	549	17	155	23	2507
37	0	55	14	0	0	40
38	0	0	4	0	0	57
39	.	.	5	.	2	45
40	0	0	0	0	0	0
41	0	15	0	0	0	31
42	0	0	0	0	0	0
43	0	0	0	2	0	353
44	158	0	0	0	0	0
45	35	53	0	0	5	41
46	302	0	104	0	0	720
47	0	0	0	0	0	165
48	0	0	0	0	0	1
49	0	88	0	81	0	12
50	3	13	0	0	0	0
51	187	7	0	210	0	368

52	0	1	83	4	0	167
53	76	1	25	0	0	244
54	0	0	0	0	0	0
55	0	0	0	0	0	177
56	0	0	0	0	0	248
57	0	80	29	80	0	0
58	59	.	70	0	0	23
59	0	0	0	0	0	2
60	21	72	0	186	0	76
61	0	0	0	0	0	31
62	8130	4214	419	597	202	5425
63	40	0	100	0	0	629
64	0	0	0	0	0	0
65	0	13262	161	1022	101	3197
66	358	32	97	48	0	1344
67	656	58	11	9	14	95
68	87	2285	710	4	0	2129
69	4	0	0	0	0	1476
70	0	0	45	0	0	223
71	4	205	25	36	0	662
72	242	610	128	13	0	218
73	0	0	0	0	0	0
74	352	540	587	114	0	81
75	53	0	0	0	0	187
76	53	0	0	38	0	0
77	0	0	0	0	0	65

78	0	0	0	0	0	0
79	0	0	0	0	0	4
80	0	0	0	0	0	0
81	0	0	0	0	0	118
82	0	0	0	0	0	1
83	0	0	93	0	0	51
84	0	0	0	0	0	14
85	0	0	0	0	0	67
86	0	0	7	0	191	122
87	.	.	.	.	.	.
88	0	0	0	0	0	0
89	2	14	.	14	.	15
90	0	0	0	0	0	2

LEA	PART-TIME ADMIN.	PART-TIME TEACHER	PART-TIME COUSELOR	PART-TIME PARAPROF.	PART-TIME ADMIN.	FULL-TIME TEAC.
01	0	0	0	0	2	0
02	3	52	0	1	4	5
03	1	6	0	0	0	1
04	0	26	0	4	1	9
05	0	13	2	0	1	1
06	8	166	25	3	14	9
07	0	1041	22	77	43	138
08	23	74	10	2	12	11
09	0	3	1	0	1	3
10	2	8	0	1	1	1
11	0	18	1	1	4	8
12	7	5	3	3	0	0
13	0	29	0	0	4	0
14	0	5	0	4	1	0
15	5	193	0	12	4	4
16	0	35	3	0	1	0
17	0	0	0	0	25	120
18	25	2278	52	84	128	102
19	4	110	0	0	6	2
20	0	6	0	1	3	7
21	1	78	9	3	5	8
22	1	11	0	0	2	6
23	8	331	3	11	18	12
24	1	8	0	4	0	0
25	0	19	2	4	2	11

26	0	3	0	0	0	0
27	.	.	.	.	.	.
28	0	8	0	0	1	3
29	1	5	0	1	0	0
30	1	5	1	0	6	3
31	0	51	0	2	2	0
32	3	64	3	0	10	5
33	2	0	1	0	0	0
34	12	655	36	45	27	42
35	2	2	1	0	1	0
36	0	117	0	88	4	5
37	1	23	1	6	2	0
38	0	7	0	0	2	15
39	0	3	0	0	1	1
40	1	8	1	0	2	3
41	1	2	0	0	0	2
42	0	20	0	0	1	0
43	0	25	0	0	1	6
44	1	32	0	0	7	1
45	3	0	0	0	1	0
46	1	72	0	22	8	13
47	0	9	0	0	3	0
48	1	3	0	0	0	4
49	1	0	0	0	1	0
50	1	1	0	1	0	0
51	0	65	0	10	4	9

52	1	41	0	4	8	9
53	2	10	1	0	8	18
54	0	0	0	0	2	2
55	3	28	1	0	3	0
56	0	8	1	3	2	3
57	3	2	0	0	0	0
58	0	9	0	0	1	0
59	1	11	0	2	1	0
60	0	27	0	0	2	1
61	0	3	0	0	1	2
62	25	265	27	0	29	98
63	5	19	5	4	3	2
64	0	0	0	0	4	1
65	5	471	15	20	32	38
66	1	138	6	0	10	12
67	9	79	0	18	6	21
68	0	237	38	0	16	51
69	3	341	7	12	6	17
70	0	17	2	0	2	8
71	0	49	1	9	3	3
72	5	49	0	0	5	5
73	2	4	0	1	0	0
74	0	43	0	7	2	3
75	0	52	1	14	1	1
76	0	17	0	0	1	1
77	0	30	1	3	1	0

78	1	4	0	0	2	2
79	1	1	0	1	0	0
80	1	0	2	1	0	2
81	0	4	0	0	1	3
82	1	4	0	0	0	0
83	0	4	0	0	1	2
84	1	0	0	0	0	2
85	0	9	0	2	1	3
86	0	.	.	.	1	.
87	.	.	.	.	.	.
88	1	1	1	1	.	.
89	3	.	.	.	.	.
90	0	2	0	0	1	0

LEA	FULL-TIME COUNSELOR	FULL-TIME PARAPROF.	VOLUNTEER ADMIN.	VOLUNTEER TEACHER	VOLUNTEER COUNSELOR	VOL PAR.
01	0	0	0	43	0	0
02	1	1	0	71	0	0
03	0	1	0	0	0	18
04	1	1	0	0	0	59
05	0	1	0	3	0	2
06	2	5	3	2	0	258
07	20	16	0	4	1	211
08	6	0	0	0	0	0
09	0	1	0	0	0	0
10	0	0	175	0	0	0
11	3	0	0	0	0	40
12	0	0	0	0	0	0
13	1	0	0	0	0	66
14	0	0	0	0	0	0
15	0	2	0	128	0	0
16	0	0	0	1	0	1
17	25	23	0	8	0	0
18	60	49	2	22	0	4
19	0	0	0	415	0	0
20	1	0	0	12	0	0
21	0	4	0	1	0	6
22	1	3	9	0	0	68
23	4	0	0	4	0	0
24	0	0	0	0	0	0
25	0	0	0	2	0	4

26	0	0	0	0	0	0
27	.	.	.	.	.	.
28	0	1	0	2	0	0
29	0	0	0	0	0	4
30	1	0	0	2	0	0
31	0	4	0	9	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	1
34	8	3	0	39	0	4
35	0	0	2	0	0	0
36	0	3	0	0	0	0
37	0	1	0	1	0	0
38	1	10	0	30	0	0
39	0	0	0	0	0	2
40	0	1	0	0	0	2
41	0	0	0	0	0	0
42	0	0	.	21	0	0
43	1	0	0	0	0	0
44	1	0	0	45	0	0
45	0	0	26	331	0	0
46	3	6	0	463	0	0
47	0	0	0	3	0	0
48	0	4	0	0	0	0
49	0	0	130	0	0	0
50	0	0	12	43	0	26
51	1	1	0	0	0	54

52	2	3	2	22	.	1
53	1	7	0	3	0	0
54	0	1	0	0	0	0
55	0	0	3	0	0	0
56	0	3	0	20	0	0
57	0	1	0	11	0	8
58	0	0	0	0	0	0
59	0	0	0	0	0	0
60	1	0	0	0	0	74
61	0	0	0	0	0	0
62	23	0	0	0	0	282
63	1	0	0	0	0	2
64	0	0	2	245	0	0
65	3	6	0	228	0	0
66	2	3	0	447	0	0
67	3	2	1	1	0	57
68	3	4	139	194	1	150
69	2	0	0	12	0	0
70	1	0	0	0	0	103
71	1	1	0	0	0	142
72	0	0	4	0	0	169
73	0	0	0	0	0	0
74	1	0	0	78	0	0
75	1	5	0	0	0	0
76	0	0	0	0	0	15
77	0	0	0	20	0	0

78	1	2	0	0	0	0
79	0	0	6	6	0	2
80	0	0	0	0	0	1
81	1	4	0	0	0	0
82	0	0	0	0	0	0
83	1	0	0	0	0	36
84	1	2	0	0	0	0
85	0	5	0	6	0	0
86	.	3	.	.	.	.
87	.	.	.	.	.	.
88	.	.	.	.	.	.
89	.	.	71	.	.	.
90	0	0	0	0	0	0

LEA/ FRINGE	SALARY	OTHER SERVICE	OTHER EXPENSE	MATERIALS SUPPLIES	CAPITAL OUTLAY
01	0	0	0	0	0
0					
02	518952	14694	39390	274163	3468
99952					
03	69320	2660	3090	7355	0
20738					
04	500877	5862	16632	11154	18825
152667					
05	23002	4404	1993	974	983
6826					
06	819004	409818	758377	0	7315
0					
07	12523414	907061	681821	768	843121
2433865					
08	0	0	0	0	0
0					
09	59254	1100	1937	0	0
17072					
10	114536	4686	37600	246628	1261
42045					
11	242968	4115	18814	3379	14457
72310					
12	0	0	0	0	0
0					

13	119936	3652	13474	0	536
36013					
14	0	0	0	0	0
0					
15	1150190	31852	75244	674135	46747
410556					
16	78173	3044	1603	81	240
23902					
17	8375752	96820	536305	0	52375
0					
18	27080752	9358577	527521	9497	153764
9019871					
19	1525658	461486	141108	0	5254
0					
20	292612	13456	11205	4766	8205
99443					
21	694258	3147	10316	70480	10188
212117					
22	284371	96992	30399	58485	43196
93797					
23	2850516	428699	134007	0	0
0					
24	28830	568	3585	272	234
10704					
25	373413	8633	8287	39	4482
117555					

26	9872	119	698	0	0
2992					
27	11234	460	630	0	73
2714					
28	91001	5498	5580	0	105
32653					
29	16646	996	1169	124	149
2535					
30	185324	12782	13281	27913	3555
58649					
31	119965	742	9338	41041	86
28077					
32	288885	7473	25744	53335	5253
89079					
33	0	0	0	0	0
0					
34	4671391	81194	90479	91653	11115
1002683					
35	0	0	0	0	0
0					
36	1165544	344311	104488	0	3419
0					
37	137011	5502	7763	4164	7981
48781					
38	1577687	37123	28036	175497	48787
523573					

39	0	0	0	0	0
0					
40	111238	2540	15418	887	2066
32166					
41	16654	222	1756	467	1424
4216					
42	80290	73990	4729	0	9090
0					
43	259251	18650	15931	8481	12274
80862					
44	1336979	11660	32172	22717	20748
249980					
45	0	0	0	0	0
0					
46	1381378	41827	88738	35723	54452
400126					
47	49971	882	510	19	0
9410					
48	278821	160	442	4719	1
82945					
49	0	0	0	0	0
0					
50	0	0	0	0	0
0					
51	539521	7979	7660	20833	61034
150747					

52	633822	44706	91870	11567	4736
204794					
53	892248	78830	90625	232344	25790
321424					
54	48960	0	0	0	0
0					
55	66371	6546	8358	101052	0
22790					
56	51872	9275	9848	25767	10846
13886					
57	0	0	0	0	0
0					
58	22818	25651	8325	0	725
0					
59	45863	759	2026	610	546
13601					
60	219017	0	5056	0	0
0					
61	114945	2027	7570	2349	3348
32275					
62	4969160	86171	62909	25284	13922
1146111					
63	188907	3123	1012	66183	410
62459					
64	0	0	0	0	0
0					

65	2880417	136100	525291	1704679	184612
1031279					
66	705477	44016	22092	13146	18279
207610					
67	1606599	107934	132259	0	8068
0					
68	3807441	45108	90772	23412	88388
1115436					
69	1713118	31348	70329	84779	6551
547165					
70	148805	2133	9748	21372	4620
44458					
71	1063622	14816	9235	0	42024
211673					
72	1419779	105034	116098	0	97168
0					
73	48960	0	0	0	0
0					
74	555307	61461	23741	0	779
0					
75	200154	25155	22975	6584	36943
71366					
76	152174	30170	31685	2427	251093
0					
77	32597	1108	4932	23667	372
9504					

					163
78	91325	3640	2192	16525	0
27491					
79	0	0	0	0	0
0					
80	48140	0	22781	2810	47
0					
81	124651	2980	9081	132	16577
35028					
82	17488	262	1260	0	0
5215					
83	119893	3447	6469	1196	3549
37993					
84	20637	352	217	1283	692
6190					
85	179491	12091	13118	772	5043
54719					
86	0	0	0	0	0
0					
87	6944	547	465	0	0
1885					
88	880194	0	0	0	0
0					
89	4275	781	327	173	193
1397					
90	6759	35	1562	0	7703
1691					

LEA	STATE AND FEDERAL COSTS FOR DISTRICTS AND STATE COSTS FOR COMMUNITY COLLEGES	FEDERAL GRANTS FOR COMMUNITY COLLEGES AND OTHER LEAS OTHER THAN DISTRICTS
01	0	40451.20
02	1024375	0
03	130531	0
04	768400	0
05	46230	0
06	2525651	406368.88
07	17463428	0
08	.	.
09	96468	0
10	472100	0
11	446143	0
12	0	0
13	173743	0
14	0	11042.77
15	2407365	0
16	133436	0
17	9061252	595489.22
18	47455378	0
19	2394480	122109.42
20	452817	0
21	1059685	0
22	674297	0
23	3436774	497412.39

24	49757	0
25	606178	0
26	13681	0
27	25025	0
28	150011	0
29	23708	0
30	336989	0
31	211979	0
32	503032	0
33	0	61941.10
34	6033986	0
35	0	45000.00
36	1617762	69873.91
37	239842	0
38	2459413	0
39	0	87905.65
40	228865	0
41	31834	0
42	177538	13106.00
43	454862	0
44	1771910	0
45	0	60794.99
46	2065060	0
47	60792	0
48	377903	0
49	0	36448.28

50	0	0
51	913049	0
52	1063635	0
53	1641261	0
54	48960	51790.04
55	234746	0
56	128940	0
57	0	147949.37
58	57519	23985.38
59	77938	0
60	230276	97054.65
61	178497	0
62	6391471	0
63	336253	0
64	0	0
65	6800736	0
66	1103375	0
67	1854873	54894.07
68	5397400	0
69	2683511	0
70	257499	0
71	1399266	0
72	2043059	125781.53
73	48960	65944.31
74	641288	46642.75
75	413105	0

76	251093	37120.00
77	85478	0
78	173704	0
79	0	46190.24
80	79258	65849.04
81	205419	0
82	36971	0
83	204225	0
84	29371	0
85	485109	37864.15
86	0	63090.12
87	9841	0
88	880194	0
89	7146	25176.97
90	23667	0

APPENDIX B
LISTS OF LOCAL EDUCATION AGENCIES

<u>Name</u>	<u>LEA Number</u>
<u>For Fiscal Year 1992-1993</u>	
Bay County Public Library	01
Alachua County School District	02
Baker County School District	03
Bay County School District	04
Bradford County School District	05
Brevard Community College	06
Broward County School District	07
Broward Employment and Training Administration	08
Calhoun County School District	09
Charlotte County School District	10
Citrus County School District	11
City of Ft. Lauderdale (Gateway)	12
Clay County School District	13
Collier County Housing Authority	14
Collier County School District	15
Columbia County School District	16
Correctional Education School Authority	17
Dade County School District	18
Daytona Beach Community College	19

DeSoto County School District	20
Escambia County School District	21
Flagler County School District	22
Florida Community College at Jacksonville	23
Franklin County School District	24
Gadsden County School District	25
Gilchrist County School District	26
Glades County School District	27
Gulf County School District	28
Hamilton County School District	29
Hardee County School District	30
Hendry County School District	31
Hernando County School District	32
COFFO/SDIA	33
Hillsborough County School District	34
Hispanic Unity of Florida, Inc.	35
Indian River Community College	36
Indian River County School District	37
Jackson County School District	38
Jacksonville Public Library	39
Jefferson County School District	40
Lafayette County School District	41
Lake City Community College	42
Lake County School District	43
Lee County School District	44
Leon County Public Library	45

Leon County School District	46
Levy County School District	47
Liberty County School District	48
Literacy Volunteers--Monroe	49
Literacy Volunteers--Washington	50
Manatee County School District	51
Marion County School District	52
Martin County School District	53
Miccousukee Indians	54
Monroe County School District	55
Nassau County School District	56
North Florida Education Development	57
North Florida Junior College	58
Okaloosa County School District	59
Okaloosa-Walton Community College	60
Okeechobee County School District	61
Orange County School District	62
Osceola County School District	63
Palm Beach County Library System	64
Palm Beach County School District	65
Pasco County School District	66
Pensacola Junior College	67
Pinellas County School District	68
Polk County School District	69
Santa Rosa County School District	70
Sarasota County School District	71

Seminole Community College	72
Seminole Indians	73
South Florida Community College	74
St. Johns County School District	75
St. Johns River Community College	76
Sumter Community School District	77
Suwannee County School District	78
Florida Endowment Fund	79
Tampa--Hillsborough Urban League	80
Taylor County School District	81
Union County School District	82
Wakulla County School District	83
Walton County School District	84
Washington-Home Vocational School	85

For Fiscal Year 1991-1992

ACTION, INC.	86
Dixie County School District	87
Glades County School District	88
Dozier Schools of Florida	89
Washington County Council on Aging, Inc.	90

APPENDIX C
ANALYSIS OF COOK'S D PRINT-OUT

DEPENDENT VARIABLE Y1

Obs					Cook's
	-2	-1	0	1 2	D
1		*			0.011
2		****			0.039
3			****		0.016
4		*			0.001
5			**		0.008
6			*		0.007
7					0.000
8					0.000
9			***		0.114
10					0.006
11					0.001
12					0.002
13					0.001
14					0.001

1

The SAS System

17:10 Monday,

September 5, 1994

Obs					Cook's
	-2	-1	0	1 2	D
15		*			0.018
16					0.002
17			*		0.106
18		*			0.013
19			*		0.012
20					0.003
21		*			0.002
22			***		0.034
23		*			0.004
24			***		0.023
25		*			0.010
26			*		0.002
27					.
28		*			0.002
29		***			0.017
30					0.000
31					0.002
32		*			0.003
33					0.000
34					0.001
35					0.003

36		***		0.056
37		*		0.002
38				0.006
39				.
40		*		0.003
41		*		0.005
42		*		0.027
43				0.000
44		*****		0.050
45				0.002
46		*		0.008
47		**		0.028
48				0.000
49		*		0.021
50				0.001
51				0.000
52				0.000
53		*		0.007
54		*		0.011
55		**		0.032
56		****		0.061
57				0.000
58		***		0.101
59				0.001
60		*		0.007
61				0.000

62		*			0.003
63					0.000
64					0.000
65		****			0.031
66					0.001
67					0.000
68					0.001

1

The SAS System

5

17:10 Monday,

September 5, 1994

Obs	-2	-1	-0	1	2	Cook's D
69		*				0.004
70		*				0.004
71				**		0.007
72				***		0.017
73						0.001
74		*				0.008
75				***		0.015
76						0.000
77						0.000
78		***				0.015
79						0.005

80		*		0.019
81				0.003
82				0.002
83				0.000
84				0.000
85		*		0.005
86				.
87				.
88				.
89				.
90		**		0.010

Sum of Residuals 0

Sum of Squared Residuals 0.2410

Predicted Resid SS (Press) 0.3216

Dependent Variable: T

				Cook's
Obs	-2	-1	-0 1 2	D
1		*		0.013
2				0.001
3		*		0.001
4		*		0.001
5		*		0.004

6					0.002
7					0.001
8					.
9					0.004
10					0.001
11		*			0.002
12		*			0.048
13					0.000
14					0.002

1

The SAS System

4

17:12 Monday,

September 5, 1994

Cook's					
Obs	-2	-1	-0	1	2
	D				
15					0.005
16		*			0.003
17			*		0.116
18					0.000
19					0.001
20		**			0.021
21			*		0.002
22			***		0.027
23					0.000

24				0.002
25		**		0.028
26				0.000
27				.
28		*		0.001
29				0.000
30				0.001
31				0.000
32				0.000
33		*		0.027
34				0.000
35				0.002
36				0.001
37				0.000
38		*****		0.251
39				.
40		*		0.003
41		****		0.065
42				0.005
43				0.000
44				0.001
45				0.001
46				0.001
47		*		0.014
48		*****		0.350
49		*		0.043

50		**			0.032
51					0.001
52					0.000
53		*			0.006
54			***		0.097
55					0.005
56					0.002
57			*		0.029
58					0.000
59		*			0.002
60					0.004
61			**		0.013
62					0.002
63					0.000
64		**			0.026
65					0.000
66					0.001
67					0.000
68		*			0.001

1

The SAS System

5

17:12 Monday,

September 5, 1994

Cook's

Obs -2-1-0 1 2

D

69				0.001
70		**		0.005
71				0.000
72				0.000
73		*****		0.098
74				0.000
75		*		0.002
76		*		0.002
77				0.001
78				0.000
79				0.002
80				0.002
81				0.000
82				0.001
83		**		0.010
84		***		0.050
85		***		0.033
86				.
87				.
88				.
89				.
90		**		0.008

Sum of Residuals	0
Sum of Squared Residuals	12.9985
Predicted Resid SS (Press)	19.2050

APPENDIX D
LOCAL EDUCATION AGENCIES
NOT INCLUDED ON FEDERAL REPORT

University of Florida	01
Florida Atlantic University	02
Florida State University	03
Literacy Volunteers of America	04
Florida Literacy Coalition	05
University of South Florida	06

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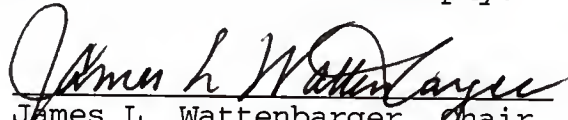
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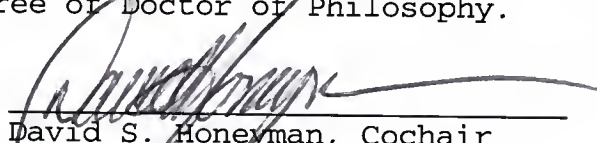
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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


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